POLARAD

PROVEN RELIABILITY

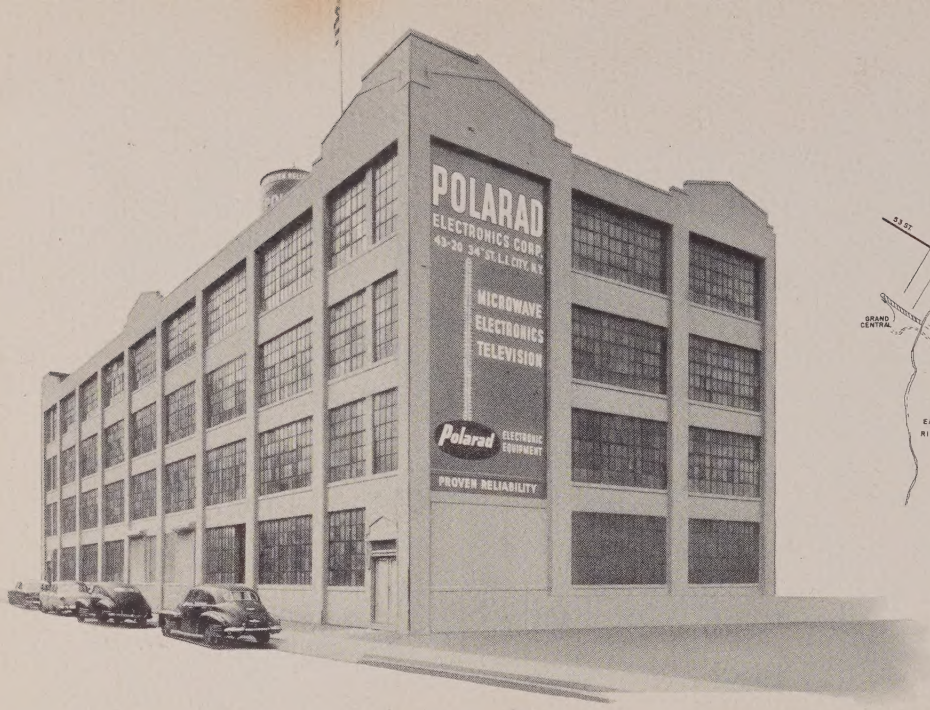
HANDBOOK
OF
OPERATING INSTRUCTIONS

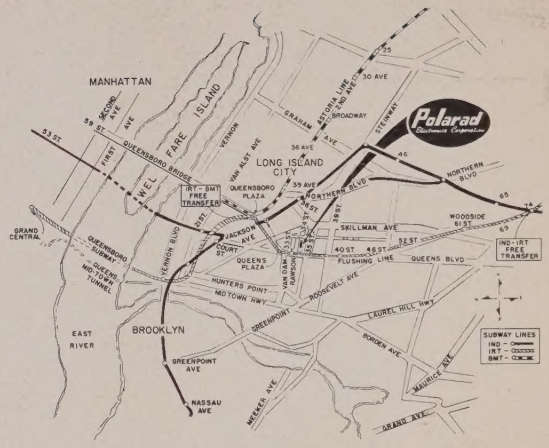
INSTRUCTION MANUAL

G-48 MODEL PMX #110

MICROWAVE SIGNAL GENERATOR

POLARAD ELECTRONICS CORPORATION, 43-20 34th STREET, LONG ISLAND CITY 1, N.Y.





LOCATION

PLANT 1

FACT

PLANT 2

LONG ISLAND CITY, NEW YORK

WAREHOUSE FACILITIES

BROOKLYN, N. Y.

POLARAD ELECTRONICS CORPORATION 43-20 34th STREET, LONG ISLAND CITY 1, N. Y.

POLARAD ELECTRONICS CORPORATION
43-20 34th STREET
LONG ISLAND CITY 1, NEW YORK

INSTRUCTION MANUAL

G-48 MODEL PMX #110

MICROWAVE SIGNAL GENERATOR

Warranty

Polarad Electronics Corporation warrants each instrument of its manufacture to be free from defects in material and workmanship. Our obligation under this Warranty is limited to servicing or adjusting any instrument returned to our factory for that purpose, and to making good at our factory any part or parts thereof except tubes, fuses or batteries, which shall, within one year after making delivery to the original purchaser, be returned to us with transportation charges prepaid, and which on our examination shall disclose to our satisfaction to have been thus defective.

Polarad Electronics Corporation reserves the right to make changes in design at any time without incurring any obligation to install same on units previously purchased.

This Warranty is expressly in lieu of all other obligations or liabilities on the part of the Polarad Eectronics Corporation, and Polarad neither assumes nor authorizes any other person to assume for them any other liability in connection with the Sales of Polarad's instruments.

Polarad
Electronics Corporation

TABLE OF CONTENTS

Section		Page
1.	INTRODUCTION	
1-1.	Scope of Manual	1
1-2.	Purpose and Use of the Equipment	1
1-3.	General Description	2
1-4.	Technical Characteristics	3
1-5.	Electron Tube Complement	5
1-6.	Accessories Supplied	7
2.	OPERATION	
2-1.	Function of Controls	8
2-2.	Operating Instructions	13
3.	PRINCIPLES OF OPERATION	
3-1.	General	18
3-2.	Beam Power Supply	21
3-3.	Repeller Power Supply	23
3-4.	Keyer Power Supply	24
3-5.	Modulator Power Supply	24
3-6.	+210V Power Supply	24
3-7.	Klystron Oscillator Circuit	25
3-8.	Power Monitoring Circuit	27
3-9.	Attenuator	29
3-10.	Modulated Operation	30
3-11.	Internal Modulation	30
3-12.	Rate Generator Circuit	30
3-13.	Undelayed Sync Blocking Oscillator	32.
3-14.	Delay Phantastron	33
3-15.	Delayed Sync Blocking Oscillator	34
3-16.	Width Multivibrator	34
3-17.	Reset Blocking Oscillator	35
3-18.	Bi-Stable Multivibrator	35
3-19.	Pulse and Keyer Amplifier	36
3-20.	External Sync Circuit	36
3-21.	External Sync Modulation	37
3-22.	FM Modulation	37
3-23.	Protective Relays	38
3-24.	Functional Operation of the Mechanical Components	38

TABLE OF CONTENTS (Continued)

Section		Page
4.	MAINTENANCE	
4-1.	General	41
4-2.	Access to the Equipment	41
4-3.	Preliminary Inspection Procedures	42
4-4.	Trouble Shooting	47
4-5.	Checking the DC Power Supplies	58
4-6.	Checking Relays K101 and K102	59
4-7.	Replacement of RF Klystron Oscillator	60
5.	ADJUSTMENT AND ALIGNMENT	
5-1.	Power Supply Adjustments	63
5-2.	115-230V Switching System	63
5-3.	Repeller Voltage Tracking Procedure	65
5-4.	Tracking Adjustment After Replacement of a Track Potentiometer	71
5-5.	Frequency Dial Calibration	71
5-6.	Setting the LOW FREQ ADJ R217	76
5-7.	Setting the SQ. WV. SYMMETRY ADJ R211	76
5-8.	Setting the MIN DELAY ADJ R233	78
5-9.	Setting the MIN WIDTH ADJ R315	78

LIST OF ILLUSTRATIONS

Figure		Page
1-1.	Microwave Signal Generator Model PMX	v
2-1.	Microwave Signal Generator Model PMX, Front Panel	9
2-2.	Maximum Pulse Delay vs Pulse Repetition Frequency	16
3-1.	Signal Generator Model PMX, Block Diagram	19
3-2.	Power Supply, Block Diagram	22
3-3.	Klystron Oscillator, Simplified Block Diagram	26
3-4.	Repeller Voltage Characteristics Chart	28
3-5.	Microwave Signal Generator Model PMX, Electro-Mechanical Schematic Diagram	39
4-1.	Microwave Signal Generator Model PMX, Side View Right	48A
4-2.	Microwave Signal Generator Model PMX, Side View Left	48B
4-3.	Low Voltage Power Supply, Top View	49A
4-4.	Low Voltage Power Supply, Bottom View	49B
4-5.	Modulator Assembly, Component Layout	50
4-6.	Repeller and Beam Chassis, Top View	51
4-7.	Repeller and Beam Chassis, Bottom View	52
4-8.	Oscillator Cavity, Exploded View	61

LIST OF ILLUSTRATIONS (Continued)

Figure		Page
5-1.	Repeller Voltage Tracking Test Set-Up.....	
5-2.	Modulator Phase Shifting Circuit, MK-1, Schematic Diagram.....	
5-3.	Oscillator Adjustable Tuning Cam, Component Location Diagram.....	72
5-4.	Typical Mode Patterns.....	74
5-5.	Adjustments, Test Set-Up.....	
5-6.	Modulator Section, Schematic Diagram	
5-7.	Microwave Signal Generator, Model PMX, Overall Schematic Diagram Less Modulator.....	81

LIST OF TABLES

Table		Page
1-1.	Electron Tube Complement	6
2-1.	Operating Controls and Functions	8
2-2.	Modulation Control Settings	17
3-1.	Settings for Repetition Frequency Ranges	31
4-1.	Preliminary Inspection Procedure	43
4-2.	Trouble Shooting	53
4-3.	Power Supply Voltages	58
4-4.	Relays Energized	59
5-1.	Adjustments, Power Supplies	64
5-2.	Test Equipment Required for Repeller Tracking Procedure	66
5-3.	Tracking Adjustments	69

Figure 2-1. Microwave Signal Generator Model PMX, Front Panel

SECTION 1
INTRODUCTION

1-1. SCOPE OF MANUAL.

This preliminary instruction manual contains directions for the use, operation, and maintenance of Microwave Signal Generator Model PMX (figure 1-1), designed, developed, and manufactured by the Polarad Electronics Corporation, Long Island City 1, New York.

1-2. PURPOSE AND USE OF EQUIPMENT.

The Polarad Model PMX Microwave Signal Generator is a precision instrument designed to generate cw, fm, square wave, and pulse-modulated radio frequency energy over the range from 4,450 to 11,000 mc in two overlapping bands, using two precision plug-in tuning units. The Model PMX provides facilities for testing and aligning broad and narrow band microwave systems and components, such as antennas, attenuators, beacons, crystal mounts, hybrid junctions, preselectors, radars, receivers, and rf amplifiers. Specific measurements that can be taken with this equipment include, antenna gain, frequency, image rejection, power gain, selectivity, sensitivity, signal-to-noise ratio, SWR, and transmission line characteristics.

1-3. GENERAL DESCRIPTION.

The Model PMX Microwave Signal Generator is a versatile instrument which combines high accuracy, simplicity of operation, and portability. The tuning assembly of this equipment utilizes two separate and removable plug-in tuning units which are interchangeable. Tuning Unit G48 covers the frequency range from 4,450 to 8,000 mc and Tuning Unit G711, the 6,950 to 11,000 mc frequency range. A broadband external cavity klystron oscillator enables continuous tuning over the complete frequency range of each tuning unit. Each tuning unit plugs into the basic unit, which also contains the modulator, keyer, and the electronically regulated power supplies. This method of construction facilitates servicing and alignment procedures.

The Polarad Model PMX is housed in a sturdy, louvered aluminum cabinet which presents a neat and pleasing appearance. The internal components of the Model PMX are cooled by a blower fan, contained on the basic unit, to ensure reliable operation and longer life for components. The complete equipment is ruggedly constructed to operate dependably through extreme climatic and environmental conditions.

1-4. TECHNICAL CHARACTERISTICS.

Power Input.	115v-230v ± 10%, 50-60 cps, 300 watts.
Frequency Range and Accuracy.	Tuning Unit G48: 4,450 to 8,000 mc, ±1%. Tuning Unit G711: 6,950 to 11,000 mc, ±1%.
Power Output.	1 milliwatt (0 dbm) calibrated
Attenuator Output Range.	0 dbm to -127 dbm, 0.223 volts to 0.1 microvolt, (directly calibrated).
Attenuator Output Accuracy.	±2 db from 0 to -127 dbm.
Output Impedance.	50 ohms nominal.
Output VSWR.	2:1 maximum.
Output Connector.	Type N.
Modulation.	Internal or external pulse, square wave or fm.
Internal Pulse Modulation:	
Width.	0.2 to 10 microseconds.
Repetition Rate.	10 to 10,000 pps.
Delay.	2 to 2,000 microseconds.
Sync.	Internal, external pulse or sine wave.
Rise Time.	0.1 microsecond as measured between 10% and 90% of maximum amplitude of initial rise.

Decay Time.	0.1 microsecond as measured between 10% and 90% of maximum amplitude of the final decay.

Internal Square Wave:

Rate.	10 to 10,000 pps.
Symmetry.	±5%.
Sync.	Internal.

Internal FM:

Type.	Linear Sawtooth.
Frequency Deviation.	5 mc minimum.
Rate.	10 to 10,000 pps.
Sync.	Internal or external, pulse or sine wave.

External Pulse Modulation:

Polarity.	Positive or negative.
Rate.	10 to 10,000 pps.
Pulse Width.	0.2 to 100 microseconds.
Amplitude.	10 to 40 volts peak.

Output Sync Pulses:

Polarity.	Positive, delayed or undelayed.
Rate.	10 to 10,000 pps.
Amplitude.	15 volts peak minimum.
Rise Time.	less than 0.25 microsecond.

External Sync:

Type of Input.	Positive, negative or sine wave.
Amplitude.	Pulse: 5 to 50 volts peak; Sine Wave: 5 to 40 volts rms.

Size . . . . . 19-1/4 in. wide by 16-1/16 in. High by 19-13/14 in. deep.

Weight. . . . . 95 lbs.

1-5. ELECTRON TUBE COMPLEMENT.

Table 1-1 lists the various tubes used in the Model PMX Microwave Signal Generator. Refer to figures 4-3, 4-5, 4-6, and 4-8 for the location of these tubes.

TABLE 1-1. ELECTRON TUBE COMPLEMENT

Ref. Symbol	Tube Type	Function
V1	5R4GY	Rectifier
V2	5R4GY	Rectifier
V3	5933	Series Regulator
V4	12AX7	DC Amplifier
V5	5651	Voltage Regulator
V6	5651	Voltage Regulator
V7	5R4GY	Rectifier
V8	6AR6	Series Regulator
V9	12AT7	DC Amplifier
V10	5651	Voltage Regulator
V11	0A2	Voltage Regulator
V12	0A2	Voltage Regulator
V13	5Y3	Rectifier
V14	6AR6	Series Regulator
V15	12AX7	DC Amplifier

TABLE 1-1. ELECTRON TUBE COMPLEMENT (continued)

Ref. Symbol	Tube Type	Function
V16	0B2	Voltage Regulator
V17	5Y3	Rectifier
V18	6080	Series Regulator
V19	12AX7	DC Amplifier
V20	0A2	Voltage Regulator
*V101	6X4W	Protective Diode
*V102	5721	Klystron Oscillator
V103	6X4	Rectifier
V104	6AR6	Series Regulator
V105	12AX7	DC Amplifier
*V106	5965	Bi-stable Multivibrator
*V107	6AH6	Amplifier
*V108	6CL6	Amplifier
*V109	6AH6	Phase Inverter
V201	5725	Phantastron Rate Generator
V202	12AU7	A - Coupling Amplifier B - Coupling Amplifier
V203	5725	Phantastron Rate Generator
V204	12AT7	A - Cathode Follower B - Buffer Amplifier
V205	5725	Delay Phantastron
V206	5687	A - Blocking Oscillator B - Delayed Sync Blocking Oscillator
V207	12AT7	A - Phase Inverter B - Clipper Amplifier

TABLE 1-1. ELECTRON TUBE COMPLEMENT (continued)

Ref. Symbol	Tube Type	Function
V208	12AU7	Schmitt Trigger
V209	5687	A- Puller Amplifier B- Undelayed Sync Blocking Oscillator
V210	5687	A- Puller Amplifier B- Blocking Oscillator
V211	12AT7	Width Multivibrator

*Tuning Units G711 and G48.

1-6. ACCESSORIES SUPPLIED.

The following accessories are supplied with the Model PMX Microwave Signal Generator.

1 - AC line cord Part No. [illegible]

1 - RF cable Part No. [illegible]

1 - Video cable Part No. [illegible]

SECTION 2
OPERATION

2-1. FUNCTION OF CONTROLS.

Haphazard operation or improper settings of the controls can cause damage to this instrument. Therefore, it is important to know the function of every control, indicator, and connector before energizing the equipment. Table 2-1 lists the front panel designations of operating controls, indicators, connectors, and their functions. Refer to figure 2-1 for the location of the above.

TABLE 2-1. OPERATING CONTROLS AND FUNCTIONS

Controls, Indicators or Connectors	Function
POWER INPUT 115/230V 50-60 CPS	(At rear of dust cover) Connects signal generator to 115v-230v 50-60 cps source.
POWER ON-OFF switch	A double-pole, single-throw switch when in ON position applies ac power to the instrument.
POWER indicator (red)	Glows when the POWER ON-OFF switch is on ON position and power is applied.
MODULATION SELECTOR switch	Permits selection of cw, fm, square wave or pulse modulated output (internal or external).
ZERO SET control	Permits balancing of the internal thermistor bridge so that the POWER SET meter indicates ZERO.
POWER SET meter	Indicates when proper adjustment of the external klystron cavity is achieved.
POWER SET control	Permits adjustment of the external klystron cavity so that the POWER SET meter indicates POWER SET.

Microwave Signal Generator Model PMX

TABLE 2-1. OPERATING CONTROLS AND FUNCTIONS (continued)

Controls, Indicators or Connectors	Function
SIGNAL FREQUENCY control and FREQUENCY IN MEGACYCLES dial	The control sets the desired frequency which appears on the FREQUENCY IN MEGACYCLES dial.
R.F. ATTENUATOR control and ATTENUATION -DBM dial	Reduces the rf output voltage to known levels below a measured reference level as indicated on the ATTENUATION -DBM dial.
R.F. OUTPUT connector	Connects the rf output from the attenuator to the equipment under measurement.
SYNC & POLARITY SELECTOR switch	INT. MOD. & SQ. WV. position: a. Allows FREQUENCY CYCLES PER SECOND control to control the modulation repetition rate when MODULATION SELECTOR switch is in FM, INT. SQ. WV. or INT. PULSE positions. b. Permits use of DELAY MICROSECONDS, FREQUENCY CYCLES PER SECOND, AND PULSE WIDTH MICROSECONDS controls when MODULATION SELECTOR switch is in INT. PULSE position. c. Permits use of FREQUENCY CYCLES PER SECOND control when MODULATION SELECTOR switch is in INT. SQ. WV. position. SINE + or - positions: a. Repetition rate for modulation of the klystron repeller is determined by an external positive or negative pulse or sine wave. b. Permits use of the DELAY MICROSECONDS and PULSE WIDTH MICROSECONDS controls when MODULATION SELECTOR switch is in INT. PULSE position.

TABLE 2-1. OPERATING CONTROLS AND FUNCTIONS (continued)

Controls, Indicators or Connectors	Function
DELAY MICROSECONDS AND MULTIPLIER controls	Permits adjustment of the delay between the rf output pulse and the undelayed sync pulse over the range from 2 to 2,000 microseconds, but not greater than 75% of the pulse period, as shown in figure 2-2.
FREQUENCY CYCLES PER SECOND and MULTIPLIER controls	Determines the modulation repetition rate when the SYNC & POLARITY SELECTOR switch is in INT. MOD. & SQ. WV. position.
FM AMPLITUDE control	Sets the magnitude of the sawtooth signal applied to the repeller of the reflex klystron oscillator when MODULATION SELECTOR switch is in FM position.
PULSE WIDTH MICROSECONDS control	Permits adjustment of the rf pulse width from 0.2 to 10 microseconds when MODULATION SELECTOR switch is in INT. PULSE position.
EXT. MOD. connector	Permits the signal generator to be connected to a source of external modulating voltage for the klystron repeller when MODULATION SELECTOR switch is in EXT. MOD. position and SYNC & POLARITY SELECTOR switch is in SINE + or -, depending on the polarity of the external signal.
EXTERNAL SYNC. connector	Permits an external sine wave or pulse sync signal from external equipment to be connected to the signal generator to set the repetition rate when MODULATION SELECTOR switch is in FM or INT. PULSE positions and SYNC & POLARITY SELECTOR switch is in the position which corresponds to the type of external sync signal applied.

TABLE 2-1. OPERATING CONTROLS AND FUNCTIONS (continued)

Controls, Indicators or Connectors	Function
UNDELAYED SYNC. OUT connector	Permits a positive trigger pulse to be connected to the signal generator which leads the rf pulse in time when MODULATION SELECTOR switch is in FM or INT. PULSE positons.
DELAYED SYNC. OUT connector	Permits a positive trigger pulse from external equipment to be connected to the signal generator which is in time coincidence with the rf pulse when MODULATION SELECTOR switch is in FM or INT. PULSE positions.

2-2. OPERATING INSTRUCTIONS.

The following instructions are to be followed to ensure proper operation of the Model PMX Microwave Signal Generator.

a. Starting instructions.

1) Measure the line voltage to determine whether it is nominally 115 volts or 230 volts. The 115v-230v input switching system to the unit is normally factory set at 115 volts. If it is desired to use 230 volts as input to the equipment, the internal input switching system must be set at 230 volts. To Accomplish this, proceed as follows:

a) Remove the dust cover as described in paragraph 4-2.

b) The 115v-230v switch is a six-pole double-throw switch located on the basic unit at the rear of the equipment.

c) Simply place the switch in the 230v position and replace the dust cover.

2) Connect a 115v or 230v, 50-60 cps, single phase power source to the POWER INPUT 115/230V 50-60 CPS receptacle, on the rear of the dust cover, using the ac line cord supplied.

3) Throw the POWER ON-OFF switch to the ON position. The front panel POWER indicator (red) should light.

4) Allow the signal generator to warm up for at least 15 minutes.

b. Setting Frequency and Power Calibration.

The following procedure shall be used to calibrate the output power of the Model PMX.

1) Rotate the SIGNAL FREQUENCY control until the FREQUENCY IN MEGACYCLES dial indicates the desired operating frequency.

2) Set the MODULATION SELECTOR switch to ZERO SET position. This makes the rf oscillator inoperative.

3) Adjust ZERO SET control until the POWER SET meter pointer is at ZERO.

4) Set the MODULATION SELECTOR switch to CW.

5) Adjust POWER SET control until the POWER SET meter pointer is at POWER SET. The signal generator is now at the one-milliwatt power reference level for the frequency set in step 1.

6) Rotate the R.F. ATTENUATOR control until the ATTENUATION -DBM dial is set to the desired value of rf signal level. The output level is expressed in decibels below one milliwatt,working into a resistive load of 50 ohms.

NOTE

Whenever the setting of the frequency dial is changed, it is necessary to repeat the calibration procedure, as given above, in order to determine the power output.

2-3. MODULATION CONTROL SETTINGS.

The control settings to obtain the various types of modulation available with the Model PMX are listed in Table 2-2. If the instructions of paragraph b have been followed, the output, with the MODULATION SELECTOR switch in CW position, will be average power and the output, with the MODULATION SELECTOR switch in INT. PULSE and INT. SQ. WV. positions will be peak power.

2-4. PULSE DELAY VERSUS PULSE REPETITION FREQUENCY.

Figure 2-2 shows the maximum permissible setting of the DELAY controls for pulse repetition rates within the pps range of the equipment. A delay setting greater than depicted by the curve will result in false indications.

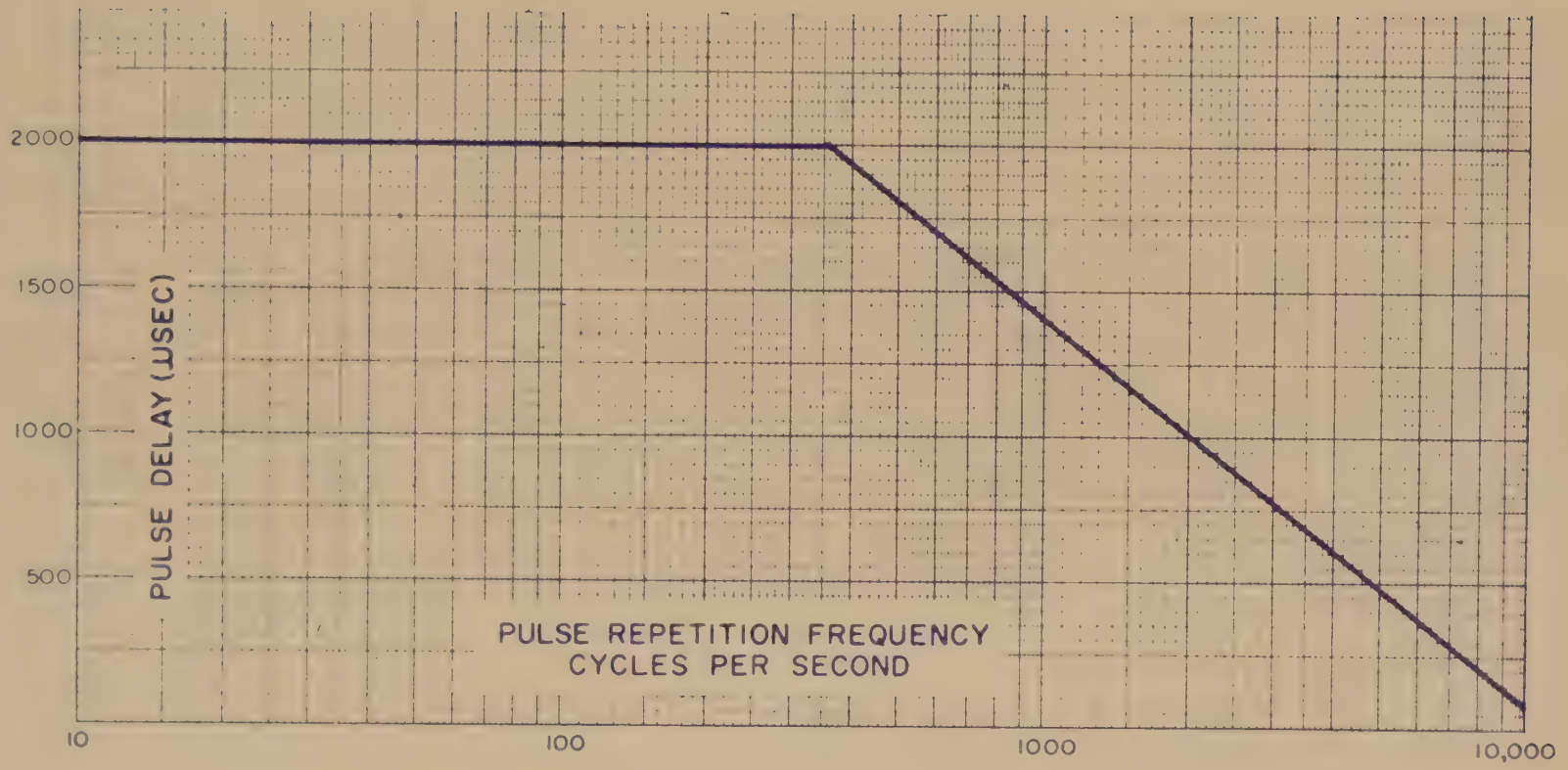


FIGURE 2-2. MAXIMUM PULSE DELAY VS. PULSE REPETITION FREQUENCY

TABLE 2-2. MODULATION CONTROL SETTINGS

MODULATION SELECTOR SETTING	SYNC & POLARITY SELECTOR SETTING	REPETITION RATE CONTROL	OUTPUT		NOTES
			RF	SYNC PULSE	
CW	SINE + or -	None	CW	None	
FM	SINE + or -	FREQUENCY CYCLES PER SECOND	FM	Delayed or Undelayed	Use FM AMPLITUDE control as required.
FM	SINE + or -	External Souce	FM	Delayed or Undelayed	a. Use FM AMPLITUDE control as required. b. Connect external source to EXTERNAL SYNC. connector.
INT. PULSE	INT. MOD. & SQ. WV.	FREQUENCY CYCLES PER SECOND	Pulse Modulated	Delayed or Undelayed	Use PULSE WIDTH and DELAY controls as required.
INT. PULSE	SINE + or -	External source	Pulse Modulated	Delayed or Undelayed	a. Use PULSE WIDTH and DELAY controls as required. b. Connect external source to EXTERNAL SYNC. connector
INT. SQ. WV	INT. MOD. & SQ. WV.	FREQUENCY CYCLES PER SECOND	Square Wave Modulated	Delayed or Undelayed	
EXT. MOD.	SINE + or -	External source	Pulse Modulated	None	Connect external source to EXT. MOD. connector.

SECTION 3
PRINCIPLES OF OPERATION

3-1. GENERAL.

The basic principles of the Polarad Microwave Signal Generator Model PMX, can be understood from the block diagram shown in figure 3-1. The signal generator provides continuous-wave, pulse-modulated, square wave-modulated, and frequency-modulated signals of known intensities and frequency in the range from 4,450 to 11,000 mc in two overlapping bands, through the use of two interchangeable, precision plug-in tuning units.

The Model PMX consists essentially of an rf reflex klystron oscillator operating in an externally tuned cavity, a modulator, a keyer, a power-monitoring bridge circuit, and five self-contained electronically regulated power supplies.

The klystron rf oscillator circuit consists of a reflex klystron tube and its associated external resonant cavity which generates the desired signal. The function of the modulator and keyer circuits is to generate a modulation voltage, either pulse, square wave, or sawtooth in waveform, and to apply this voltage to the reflex klystron oscillator tube. When pulse or square wave amplitude modulation is used, the amplitude modulated signal is applied to the grid of the klystron tube. When frequency modulation is employed, the sawtooth signal from the modulator circuit is applied to the repeller electrode of the klystron. The Model PMX is a free-running pulse generator when the SYNC & POLARITY SELECTOR switch is in the INT. MOD. & SQ. WV. position and the MODULATION SELECTOR switch is in either the INT. PULSE, INT. SQ. WV. or FM

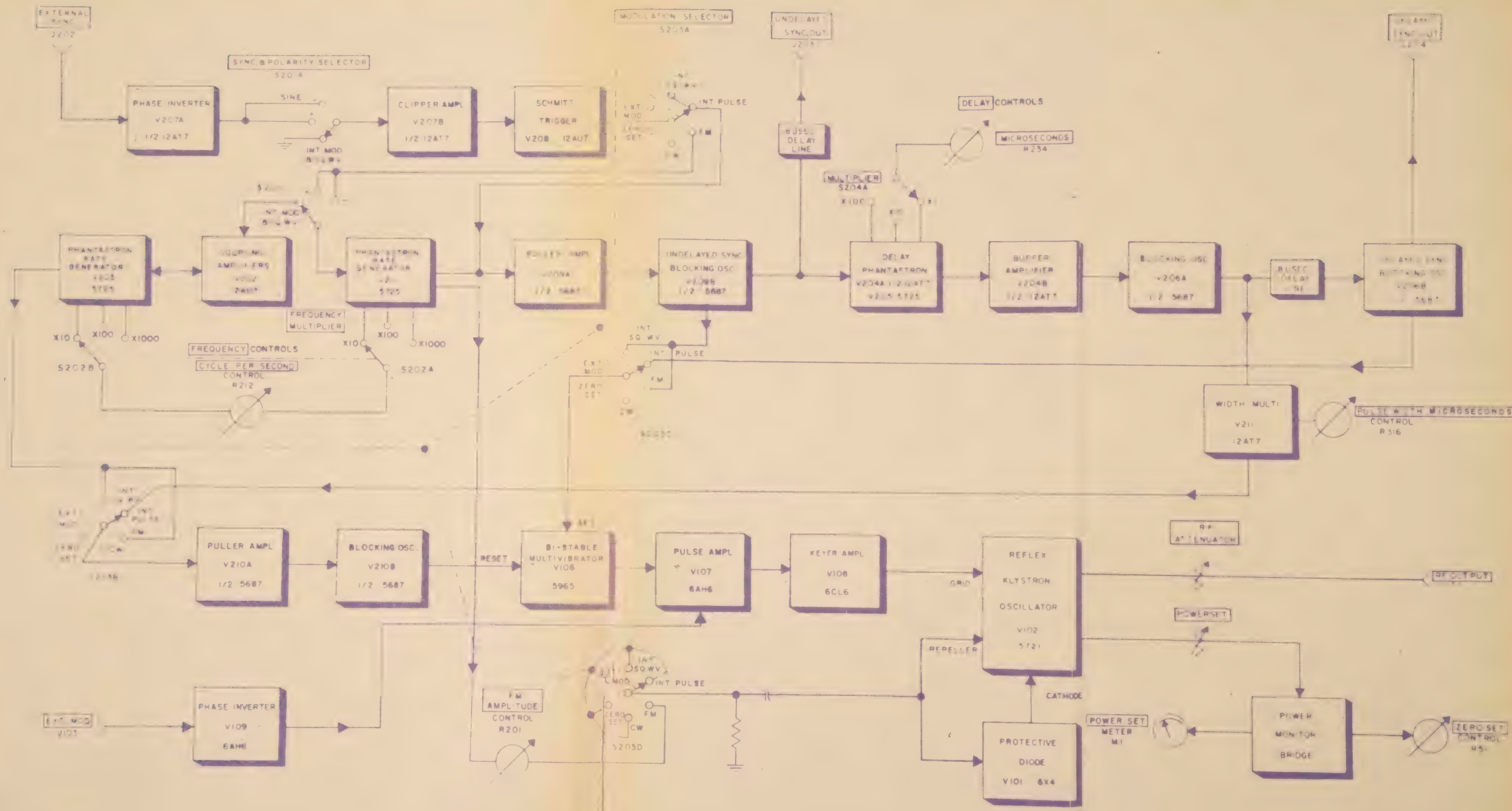


FIGURE 3-1. SIGNAL GENERATOR MODEL PMX, BLOCK DIAGRAM

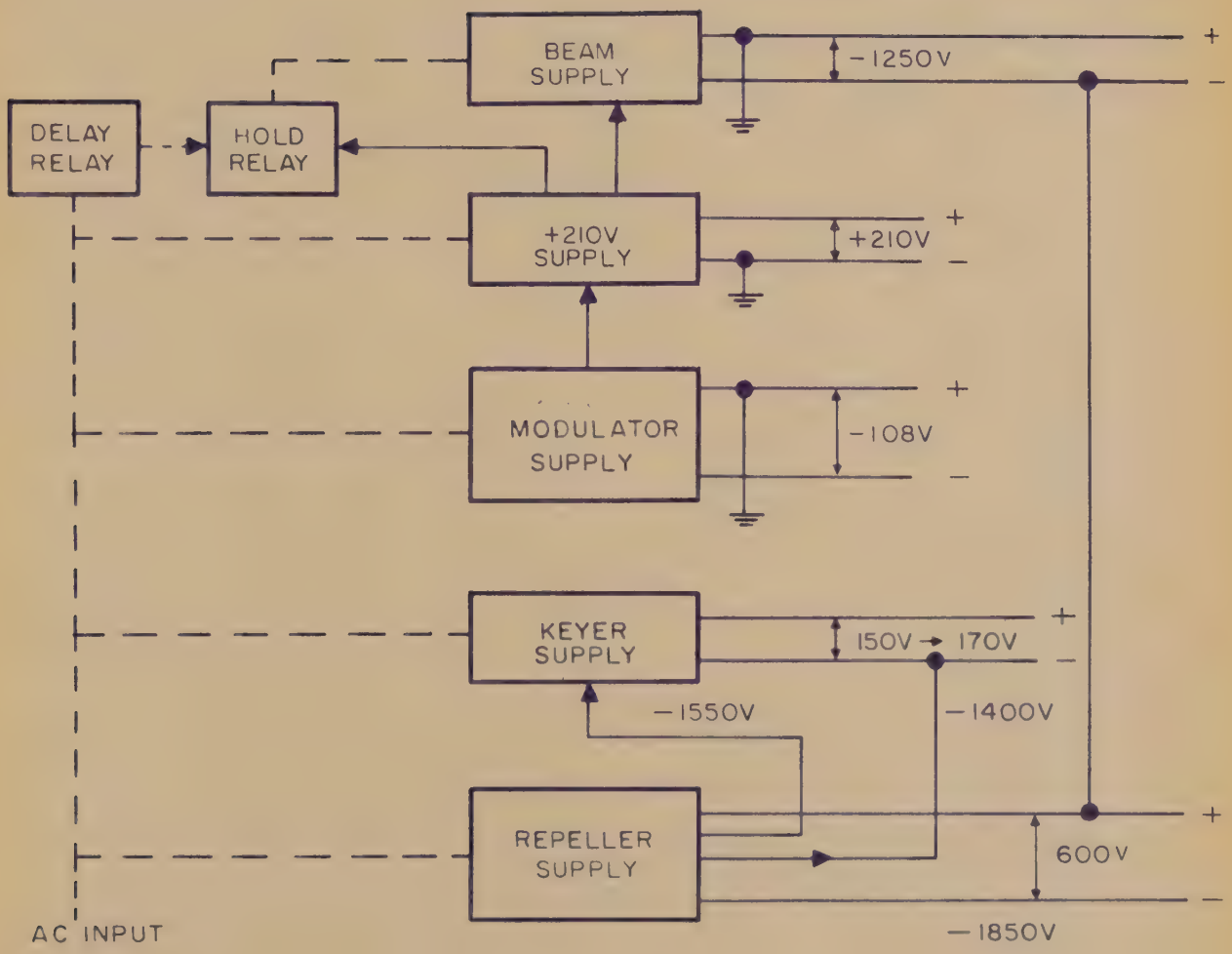


FIGURE 3-2. POWER SUPPLIES, BLOCK DIAGRAM.

positions. Provisions have been made for synchronizing the modulation voltage with an externally applied sine wave, or a pulse signal, either positive or negative, through the EXTERNAL SYNC connector. Provisions have also been incorporated to allow the repeller of the reflex klystron oscillator tube to be modulated with an external pulse signal, either single pulse or multi-pulse, through the EXT. MOD. connector on the front panel.

In addition to producing an rf test signal at the R.F. OUTPUT connector, on the front panel, the signal generator also produces video synchronizing trigger pulses. These positive polarity trigger pulses are available at the DELAYED SYNC. OUT and UNDELAYED SYNC.OUT connectors, also on the front panel.

The SIGNAL FREQUENCY knob controls the movement of both the tracking potentiometer, to vary the klystron repeller voltage, and the non-contacting plunger within the external cavity, to set the desired frequency of the signal generator.

The power monitoring circuit consists of a bridge circuit in which a sliding thermistor probe, positioned by the POWER SET control, is one arm of the bridge. The thermistor probe is located in one of the two waveguide-beyond-cutoff tubes which project from the sides of the klystron cavity. Adjustment of the thermistor probe affects the power absorbed by the thermistor, thereby changing its resistance. Consequently, the bridge is unbalanced and a pointer deflection on the POWER SET meter is indicated. The one-milliwatt power reference level is established, first, by balancing the bridge with no rf power applied, and second, by adjusting the thermistor probe until the pointer on the POWER SET meter deflects to the POWER SET position. A sliding pick-up loop

in the other waveguide-beyond-cutoff tube is employed to set the rf power output. This adjustment is controlled by the front panel R.F. ATTENUATOR when the power reference level has been set, and the ATTENUATION -DBM dial reads "0", at which time one milliwatt of rf power is available at the R.F. OUTPUT connector. When the MODULATION SELECTOR switch is in ZERO SET position, there is no rf output available at the R.F. OUTPUT connector.

Five separate power supplies are incorporated in the Model PMX. Figure 3-2 illustrates, in simplified block diagram form, the supplies, their outputs, and their relation to each other. The BEAM SUPPLY (paragraph 3-2) provides the necessary anode to cathode voltage for the klystron tube. The REPELLER SUPPLY (paragraph 3-3) provides the voltages required to enable the tracking potentiometer to vary the klystron cathode to repeller voltage. The KEYER SUPPLY (paragraph 3-4) provides the necessary voltages for the keyer circuit and also sets the grid bias for the klystron tube. The +210v SUPPLY (paragraph 3-6) provides the B+ voltage for the internal modulator and the MODULATOR SUPPLY (paragraph 3-5) the necessary voltage for the power monitor bridge plus the modulator bias voltage.

3-2. BEAM POWER SUPPLY. (See figure 5-7.)

The main function of the beam power supply is to supply the required voltages and currents to the interaction grids of the reflex klystron oscillator tube V102, so that the interaction grids are maintained at a positive potential with respect to the klystron

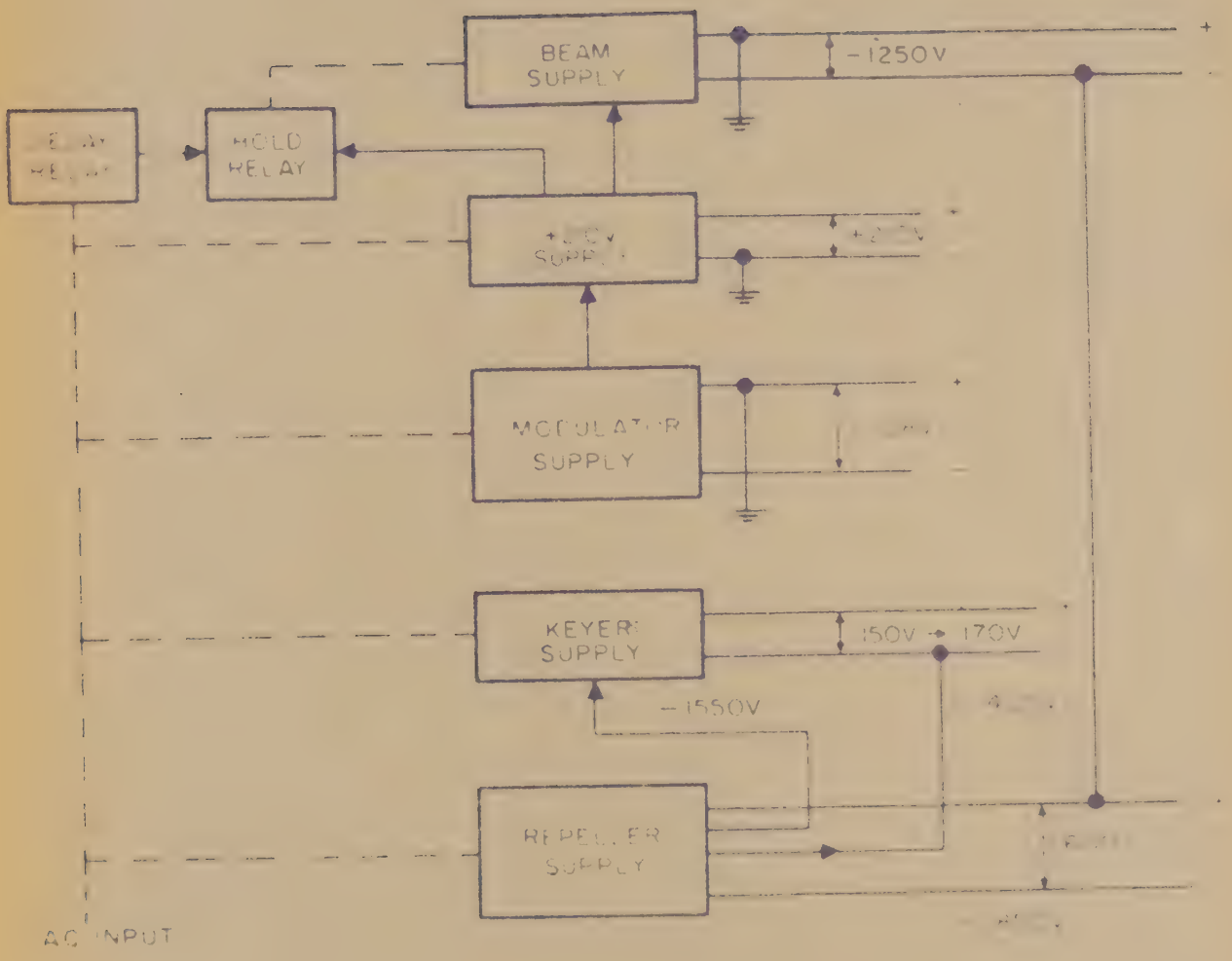

BEAM
SUPPLY
-1250V
MOLD
RELAY
MODULATOR
SUPPLY
KEYER
SUPPLY
150V → 170V
-1550V
REPELLER
SUPPLY
AC INPUT

Figure 3-2.

cathode. Since these grids contact the klystron oscillator barrel assembly, it is safer to ground the positive side of the power supply. The beam power supply consists of two voltage doubler rectifiers V1 and V2, a series regulator V3, a dc amplifier V4, and two voltage regulator tubes V5 and V6. The screen voltage for V3 is provided by the +210-volt supply. Control grid voltage for the dc amplifier is obtained through the -1250V ADJ. potentiometer R8, part of the power supply bleeder. The potentiometer is a screwdriver adjustment which sets the voltage output of the power supply to the required level.

3-3. REPELLER POWER SUPPLY. (See figure 5-7.)

The function of the repeller supply is to furnish a repeller voltage which is always negative with respect to the cathode of the klystron tube. In order to make this repeller voltage negative, the positive side of the repeller power supply is connected to the negative output of the beam power supply. Therefore, though the total output variation from the circuit is 600 volts, the absolute potential varies from -1250 volts to -1850 volts. The -1850V ADJ. potentiometer R31, is a screwdriver adjustment used to set the proper voltage for the repeller tracking circuit. A fixed -1400 volts is available at the plate of voltage regulator V12, and is used as a common reference voltage for the cathodes of the keyer power supply and keyer circuit. The -1550 volts available at the cathode of V12 is used as a negative bias and reference voltage for the keyer power supply and keyer circuit, with respect to the -1400 volt line. The repeller power supply consists of rectifier V7, series regulator V8, dc amplifier V9, and voltage regulator tubes V10, V11, and V12.

3-4. KEYER POWER SUPPLY. (See figure 5-7.)

The keyer power supply furnishes the B+ voltage for the plates and screen grids of the keyer circuit, and sets the klystron grid bias when the signal generator is set for cw operation. The keyer supply output ranges from 150 to 170 volts. The proper voltage setting is dependent upon the klystron bias needed to allow 18 to 20 milliamperes of beam current to flow in the klystron oscillator. BEAM CURRENT ADJ. potentiometer R127 is used to set the klystron grid bias when the signal generator is set for cw operation. The keyer power supply consists of V103, a full-wave rectifier, a series regulator V104 and V105, a combination dc amplifier and voltage control tube. The negative side of this supply is referenced to the -1400 volt line and is taken from a fixed reference point in the repeller power supply.

3-5. MODULATOR POWER SUPPLY. (See figure 5-7.)

The modulator power supply provides a constant -108 volts which is used to balance the power bridge circuit. In addition, the modulator supply furnished the required bias voltage for the internal modulator.. The modulator power supply consists of a full-wave rectifier V13, a series regulator V14, a dc amplifier and voltage control tube V15, and a voltage regulator tube V16.

3-6. +210V POWER SUPPLY. (See figure 5-7.)

The +210 volt power supply is a functional part of the modulator power supply and serves to provide B+ voltage for the modulator circuit. The +210 volt supply furnishes the power required to energize HOLD RELAY K2 through DELAY RELAY K1, when the normally open

contacts (3 and 8) close. Rectification is accomplished by V17, while V18 serves as a series regulator stage. V19 is a dc amplifier and voltage control tube with V20 as the voltage regulator for the power supply. +210V ADJ potentiometer R63 permits the output voltage of the power supply to be set to the required level.

3-7. KLYSTRON OSCILLATOR CIRCUIT.

The oscillator circuit uses a reflex klystron tube, operating in an externally tuned cavity, which generates cw signals (figure 3-3). The klystron cavity is in the form of a coaxial transmission line consisting of two cylinders, one inside the other. The klystron tube is inserted at one end of this transmission line so that the outer cylinder makes contact with the first interaction grid (so termed because it is closer to the cathode), while the inner cylinder makes contact with the second interaction grid. At the other end, the resonator "short" circuit is completed by a movable non-contacting plunger of special electrical design. The SIGNAL FREQUENCY knob, located on the front panel, controls the movement of the plunger within the cavity to set the resonant frequency. Simultaneously, this control adjusts the tracking potentiometer which applies the proper voltage to the klystron repeller to insure operation within its repeller mode. Two waveguide-beyond-cutoff tubes, projecting from the cavity, couple rf energy to the attenuator and the power monitor. Protective diode V101 is connected between the repeller and cathode of the klystron tube to keep the repeller from going positive with respect to the cathode.

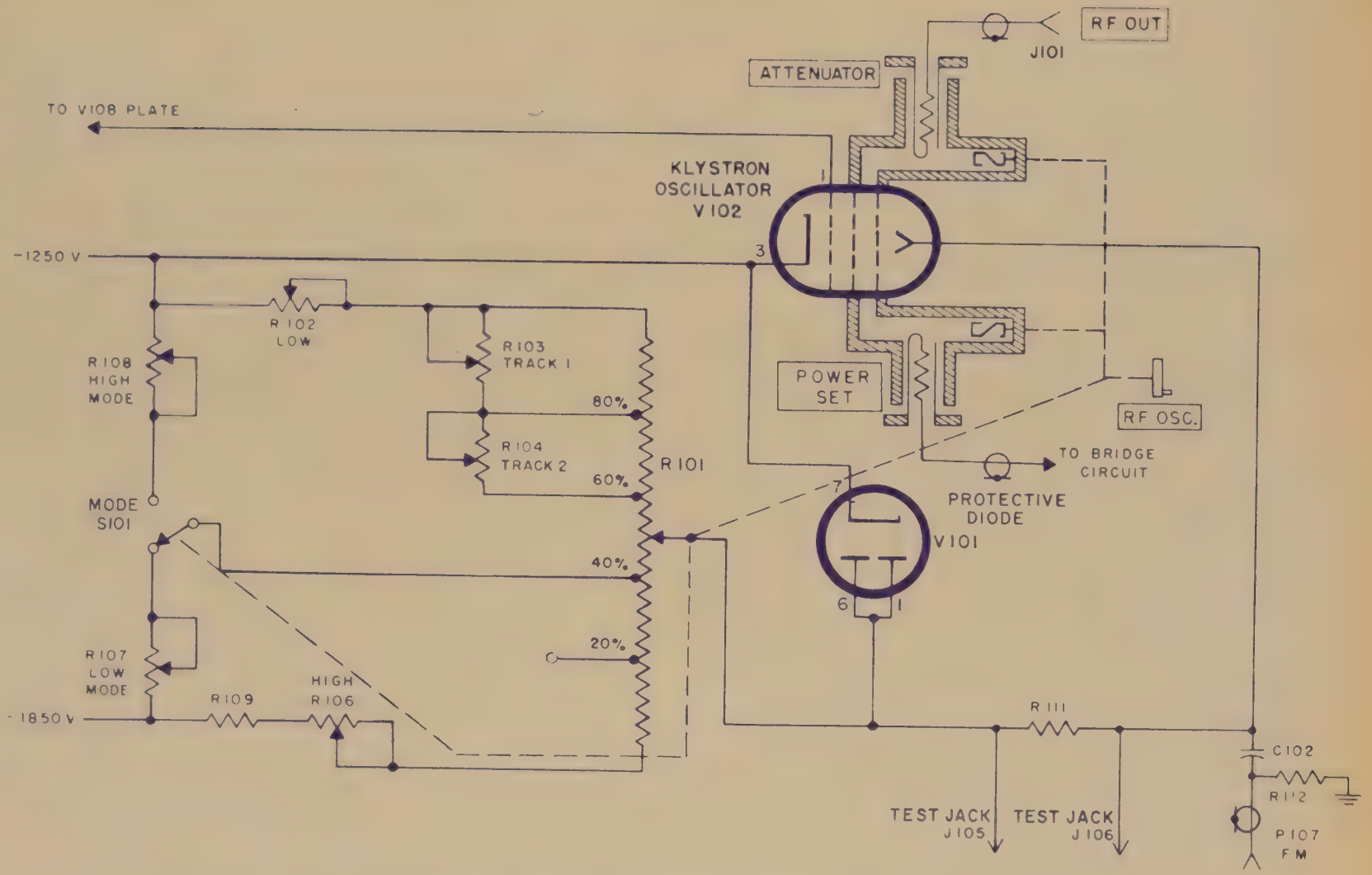


FIGURE 3-3. KLYSTRON OSCILLATOR, SIMPLIFIED SCHEMATIC DIAGRAM

The required conditions for oscillation at resonant frequencies are obtained when the klystron oscillator is operated in the 4-3/4 and 2-3/4 cycle repeller mode and the 3/4 wavelength cavity mode for the G48 tuning head. The G711 tuning head uses a 4-3/4 and 3-3/4 cycle repeller mode and a 3/4 wavelength cavity mode. Figure 3-4 is a graph showing oscillating frequencies plotted against a range of repeller voltages. This cavity frequency curve represents the repeller mode as it is determined by the tracking of the plunger (choke) and potentiometer R101, and gives the settings of potentiometers R103 through R105 (TRACK 1 through TRACK 3). Potentiometers R102 and R106 set the low and high voltage limits, respectively. The LOW MODE potentiometer R107 and the HIGH MODE potentiometer R108 are screwdriver adjustment controls, which permit the initial setting of the repeller voltage. A cam controlled by the rotation of the SIGNAL FREQUENCY knob automatically actuates MODE switch S101, thereby switching the repeller voltage from the 4-3/4 to the 2-3/4 mode for the G48 tuning head and from the 4-3/4 to the 3-3/4 for the G711 tuning head.

3-8, POWER MONITORING CIRCUIT.

The rf power monitor circuit is used to calibrate the output of the attenuator. The power monitoring circuit consists of a Wheatstone bridge of which one arm is a variable resistance element (thermistor) which measures the power. A thermistor has a negative temperature coefficient of resistance, for example, as the temperature increases, the resistance decreases, and as temperature decreases, resistance increases. Changes of thermistor temperture, and hence resistance, are governed by three factors. These are: thermal changes in its enviroment; the current flowing through it; and

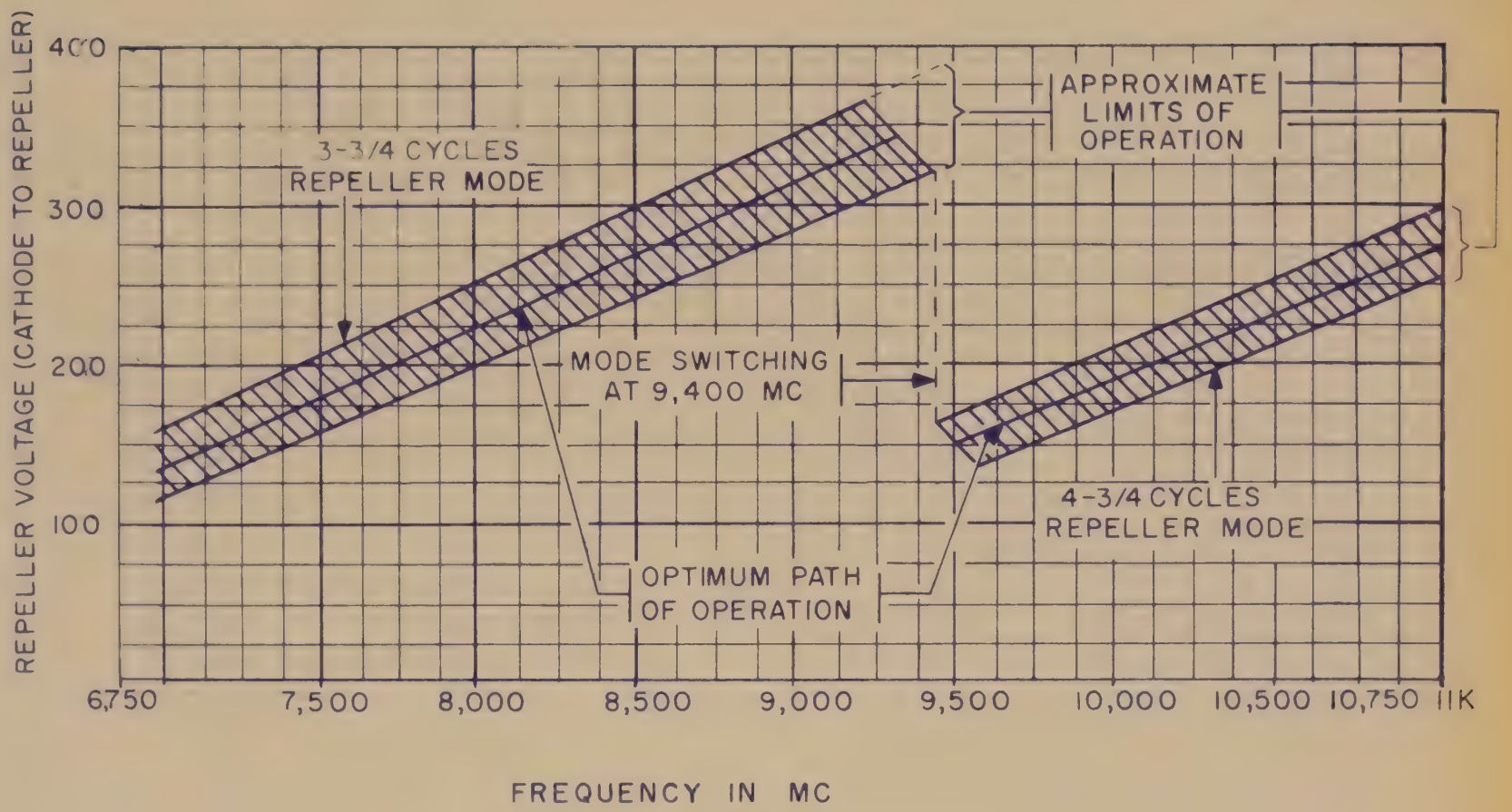


FIGURE 3-4A. 3-3/4 AND 4-3/4 REPELLER MODES
(TUNING UNIT G711, 6,950 TO 11,000 MC)

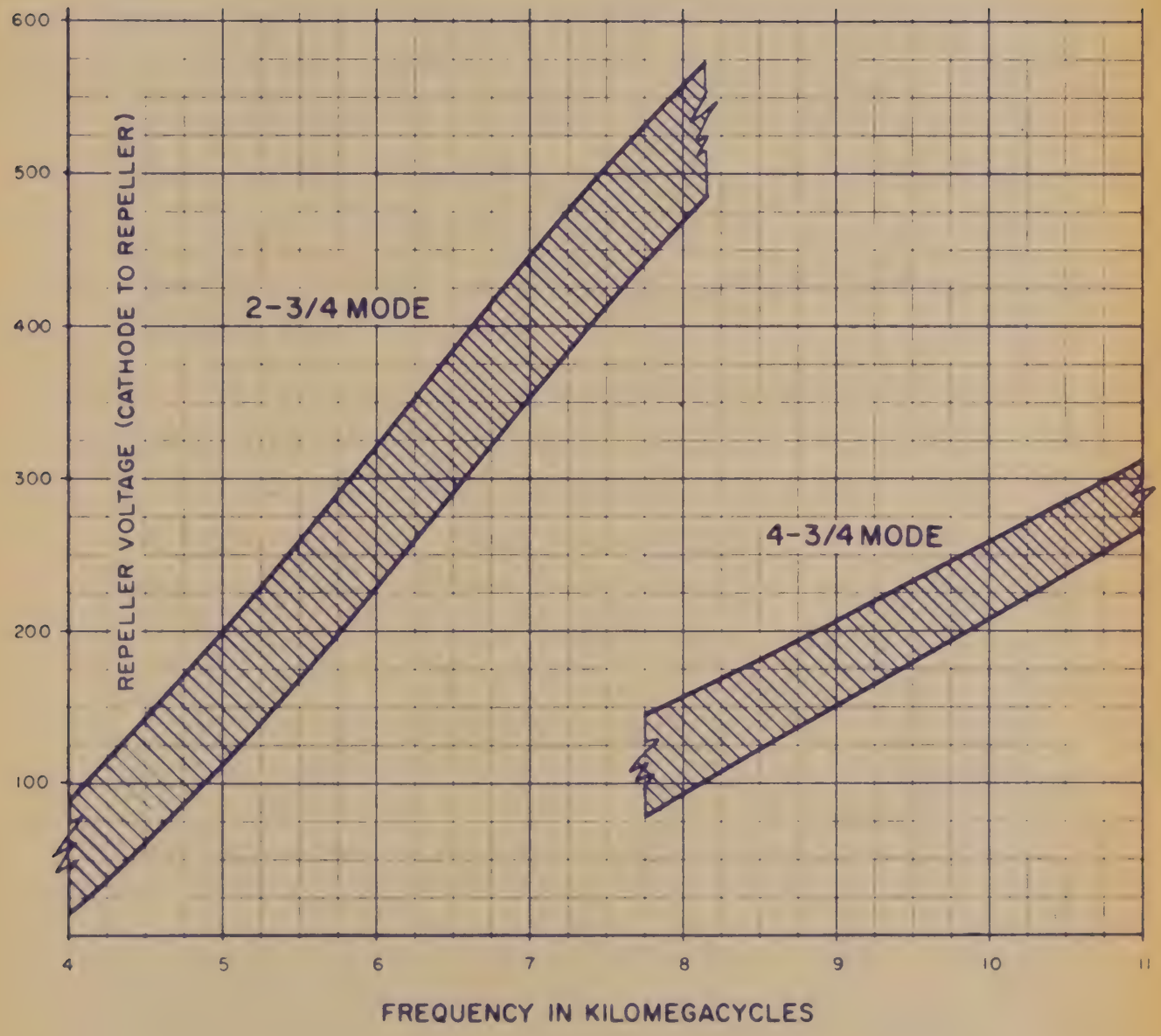


FIGURE 3-4B. 2-3/4 AND 4-3/4 REPELLER MODES
(TUNING UNIT G48, 4,450 TO 8,000 MC)

absorbed rf power. By controlling the current required for balance, the bridge will determine the rf power by measuring the change in thermistor resistance caused by the applied rf power. Two types of thermistors are used in the power monitoring circuit, the bead (RT101) and the disc (RT102 and RT103). The bead thermistor, used for power measurement, has a small mass and is affected by all of the changes mentioned above. The disc thermistor, used in compensating networks, has a large mass and its resistance is relatively insensitive to the current flowing through it. The disc thermistor is dependent, primarily, on the ambient temperature.

The basic bridge circuit is balanced (ZERO on POWER SET meter) by adjusting the ZERO SET potentiometer R51 and the COARSE ADJ potentiometer R50. The COARSE ADJ potentiometer is factory adjusted to permit the ZERO SET control to cover the entire temperature operating range. Normally, this potentiometer need not be adjusted. Adjustment is required if the POWER SET meter goes beyond full scale deflection. See table 5-1 for the procedure required for proper adjustment of COARSE ADJ R50. The power monitoring bridge is so designed that for a given frequency the bead thermistor must be inserted into the cutoff waveguide so that one milliwatt of rf power will be indicated by the POWER SET mark on the meter. Movement of the bead thermistor is controlled by the POWER SET control on the front panel.

3-9. ATTENUATOR.

The attenuator couples the resonant frequency output of the klystron oscillator to the R.F. OUTPUT receptacle on the front panel. A piston attenuator assembly is inserted into the

waveguide-beyond-cutoff tube. This assembly is controlled by the front panel R.F. ATTENUATOR control through a rack and pinion gear. The ATTENUATION -DBM dial affords direct reading of the output in decibels below a one milliwatt reference level with a 50-ohm resistive load. The setting of the one milliwatt reference level is a function of the power monitoring circuit discussed in the preceding paragraph.

3-10. MODULATED OPERATION.

When the Model PMX is switched into modulated operation, the klystron keying voltage may be supplied by an external pulse or by the modulator section. The klystron keying voltage, supplied by the modulator, may be triggered by an external pulse or an internal pulse or sawtooth. Delayed and undelayed sync pulses are available when the modulator section supplies the keying voltage.

3-11. INTERNAL MODULATION.

When SYNC & POLARITY SELECTOR switch S201 is in INT. MOD. & SQ. WV. position and MODULATION SELECTOR switch S203 is in INT. PULSE position, the signal generator functions as a self-triggered, self-synchronous pulse generator. The keying voltage is then supplied by the keyer circuit, which is triggered by the modulator section.

3-12. RATE GENERATOR CIRCUIT V201, V202, and V203.

Two identical free-running, screen-coupled phantastron circuits, connected back-to-back with coupling amplifiers, supply the necessary triggers for internal pulse and square wave modulation, plus the sawtooth voltage for frequency modulation, at a controlled repetition rate. The repetition rate is determined by the value

of capacitance switched into the plate-to-control grid circuit of the respective phantastrons by means of sections A and B of FREQUENCY MULTIPLIER S202, and by the value of resistance set by FREQUENCY CYCLES PER SECOND control R212, in conjunction with LOW FREQ. ADJ. R217 and SQ. WV. SYMMETRY ADJ. R211, in the control grid circuit of tubes V201 and V203. Table 3-1 is a convenient tabulation of various repetition frequency ranges.

TABLE 3-1. SETTINGS FOR REPETITION FREQUENCY RANGES

FREQUENCY CYCLES PER SECOND CONTROL	FREQUENCY MULTIPLIER CONTROL	REPETITION FREQUENCY RANGE
1 - 10	X10	10 - 100
1 - 10	X100	100 - 1,000
1 - 10	X1,000	1,000 -10,000

The LOW FREQ. ADJ. R217 is an internal adjustment which is used to set the low pulse frequency limit. SQ. WV. SYMMETRY ADJ. R211 is an internal adjustment which is used to make the square wave symmetrical. In pulse operation, the screen waveform of phantastron V201 is differentiated by an RC network consisting of C204 and the parallel combination of R204 and R281. The resultant pulse is then fed to puller amplifier V209A.

In SQ. WV. operation, phantastron V201 performs in the manner described above, and the suppressor waveform from phantastron V203 is differentiated by the RC network consisting of C210 and the parallel combination of R300 and R306. The resultant pulse of this

circuit is then coupled, through MODULATION SELECTOR S203B, to puller amplifier V210A. Each phantastron rate generator is operative for 50% of the total period.

In FM operation, the sawtooth output from the plate of phantastron rate generator V201 is controlled by the front panel FM AMPLITUDE control R201. This controlled sawtooth voltage is applied directly to the klystron repeller.

3-13. UNDELAYED SYNC BLOCKING OSCILLATOR V209.

Puller amplifier V209A receives the differentiated screen waveform from phantastron rate generator V201 and couples the signal to blocking oscillator V209B. Undelayed sync blocking oscillator V209B is a triggered blocking oscillator for the purpose of providing sharp pulses in either INT. PULSE or SQ. WV. position of MODULATION SELECTOR S203. Triggers of 0.25 microsecond in width, and better than 0.1 microsecond in rise time, with a minimum amplitude of 15 volts positive, are available at the UNDELAYED SYNC. OUT receptacle on the front panel. These triggers are delayed in time for 0.8 microsecond by delay line DL201. The undelayed sync pulse leads the leading edge of the modulated test segnal by an amount indicated by the delay controls. In pulse modulation, triggers from the cathode of V209B are fed to the suppressor grid of delay phantastron V205 through diode CR211, where the negative peaks are clipped. In SQ. WV. operation, the negative pulses at the plate of V209B are fed to multivibrator V106, in the keyer circuit, through S203C (part of the MODULATION SELECTOR switch) and SET J104.

3-14. DELAY PHANTASTRON V205.

The trigger at the cathode of V209B is coupled to the suppressor grid of delay phantastron V205, which is a screen-coupled phantastron circuit with a speedup cathode follower (V204A). The positive trigger applied to the suppressor grid allows the plate of the phantastron tube to draw current. When this happens, the plate voltage drops, the grid voltage drops proportionally, the cathode current falls, and the screen voltage rises. This action causes the suppressor voltage to rise because it is obtained from the same bleeder as the screen potential. The plate voltage then runs down linearly as in the Miller circuit. The end of this period comes when the control grid goes positive again, resulting in an increase of cathode current, in suppressor cutoff, and heavy screen current. The delay is adjusted by varying the RC time constant of R224 and the capacitors of DELAY MULTIPLIER S204A. The delay is also adjusted by varying the plate clamping potential of V205. DELAY MULTIPLIER selector S204A switches different value capacitors into the plate-to-grid circuit, which change the delay range. MIN DELAY ADJ R233 is used to set the minimum delay of the phantastron circuit. DELAY MICROSECONDS potentiometer R234 is the fine delay control on the front panel of the equipment.

The delayed pulse from the suppressor grid of phantastron V205 is fed to voltage divider R229 and R230, which provide bias for buffer amplifier V204B, and is applied to the grid of the buffer amplifier. Buffer amplifier V204B serves to isolate, amplify, invert, and differentiate the output signal. The positive pulse from this amplifier is coupled to blocking oscillator V206A,

which simultaneously drives delay line DL202, and the width multivibrator V211.

3-15. DELAYED SYNC BLOCKING OSCILLATOR V206B.

Delayed sync blocking oscillator V206B is a triggered blocking oscillator circuit supplying a sharp positive pulse output from the cathode and a negative pulse output from the plate. Both outputs have a repetition rate identical to the output of delay phantastron V205. The delay time of these outputs is determined by the delay phantastron output pulse. The positive pulse output from the cathode of V206B is fed to front panel DELAYED SYNC OUT receptacle J204. This positive pulse is in time coincidence with the leading edge of the modulated pulse output. The negative pulse from the plate of V206B is fed through S203C (part of the MODULATION SELECTOR switch) and SET receptacle J104 to multivibrator V106, in the keyer circuit, as the set trigger when the MODULATION SELECTOR switch is in INT. PULSE position.

3-16. WIDTH MULTIVIBRATOR V211.

The width circuit of the modulator section consists of a monostable multivibrator using a dual-triode circuit configuration. The repetition is controlled by the repetition rate of the positive driving pulse from the cathode of blocking oscillator V206A. The effective width of the multivibrator output is adjustable between 0.2 and 10 microseconds by the fine PULSE WIDTH MICROSECONDS control R316 on the front panel. MIN.WIDTH ADJ R315 sets the minimum pulse width.

In the monostable multivibrator, the positive triggering signal induces a transition from the stable to the quasi-stable state. Eventually, the multivibrator will return to its stable state, no external signal being required to induce this transition. During the cutoff period of V211B, a positive pulse followed by a negative pulse appears across the primary of plate pulse transformer T204. The pulses are inverted in T204 and coupled through C240 to the control grid of puller amplifier V210A when the MODULATION SELECTOR switch is in INT. PULSE position.

3-17. RESET BLOCKING OSCILLATOR V210.

The reset blocking oscillator resets the multivibrator (V211) when the MODULATION SELECTOR switch is in any one of the internal modulating positions. Positive pulses applied to puller amplifier V210A from either phantastron V203 or width multivibrator V211, are amplified and coupled to blocking oscillator V210B. The puller amplifier (V210A) serves to reduce the possibility of any feedback to the pulse source while providing amplification for the applied pulse. A negative trigger from the plate of blocking oscillator V210B is fed to multivibrator V106 through RESET receptacle J103.

3-18. BI-STABLE MULTIVIBRATOR V106.

Multivibrator V106 is a dual-triode regenerative circuit which is used to develop the control grid signal for amplifier V107 when the signal generator is used in INT. PULSE and SQ. WV. operation. Sharp triggering signals are employed to generate a pulse whose width is equal to the interval between the triggers. The positive output at the plate of the multivibrator is taken

from the voltage divider arrangement consisting of R131 and R134 and fed through relays K101 and K102 to the control grid of amplifier V107.

3-19. PULSE AMPLIFIER V107 and KEYER AMPLIFIER V108.

Pulse amplifier V107 amplifies pulses received from multivibrator V106 during internal modulation and the pulses from an external source during external modulation. Signals from an external source are applied to amplifier V107 via the front panel EXT. MOD. receptacle, phase inverter V109, S201D (part of SYNC & POLARITY SELECTOR switch), and relays K101 and K102. In INT. PULSE and INT. SQ. WV. operation, the negative going pulse from the plate of amplifier V107 is coupled through C115 and relay K102 to the control grid of keyer amplifier V108, driving it to cutoff. During this cutoff period, klystron oscillator V102 oscillates. The klystron cathode-to-grid voltage is determined by the setting of BEAM CURRENT ADJ R127 in the keyer supply, which is referenced to the -1400 volt line, while amplifier V108 is cutoff. In CW operation, the control grid of amplifier V108 is brough to a voltage divider consisting of R143 and R147. A negative 50 volts, with reference to the -1400 volt line, is supplied from the voltage divider which cuts off the keyer amplifier and allows the klystron to oscillate. The peak power output in pulse operation is the same as that for CW operation.

3-20. EXTERNAL SYNC CIRCUIT.

Provision is made for synchronizing the modulation voltage with an externally applied sine wave or a positive or negative

pulse signal through EXTERNAL SYNC. receptacle J202 on the front panel. After amplification and inversion by phase inverter V207A, the resultant pulse is fed to the control grid of clipper amplifier V207B which then couples the signal to the Schmitt trigger V208 and its associated circuitry. The Schmitt trigger circuit has a constant peak value output (a flat-topped pulse) which is independent of the shape of the input voltage waveform. The duration of the positive portion of the square wave output corresponds to the period that the input waveform exceeds a specific voltage.

3-21. EXTERNAL SYNC MODULATION.

Operation of the signal generator with external sync modulation is identical to internal modulation operation, except that SYNC & POLARITY SELECTOR S201 is set to correspond to the polarity of the applied external signal. The external pulse applied at the front panel EXTERNAL SYNC. receptacle J202, is used to trigger phantastron rate generator V201 when S203A (part of the MODULATION SELECTOR switch) is in either FM or INT. PULSE position.

3-22. FM MODULATION.

When MODULATION SELECTOR switch S203 is in FM position, a sawtooth voltage from the plate of phantastron rate generator V201 is fed through FM connectors J107 and P107 to C102. This capacitor couples the voltage directly to the repeller electrode of the klystron oscillator tube. The output of the klystron is then frequency-modulated at a deviation rate dependent upon the setting of the front panel FM AMPLITUDE control R201.

3-23. PROTECTIVE RELAYS.

When POWER ON-OFF switch S1 is closed, 115 volts ac is applied to all circuits except the Beam Power Supply. In order to protect the klystron oscillator tube, thermal time DELAY RELAY K1 is energized through the normally closed contacts (7 and 2) of HOLD RELAY K2. After a time delay of 60 seconds, contacts 3 and 8 of DELAY RELAY K1 close. A dc voltage from the +210-volt supply passes through the coil of HOLD RELAY K2, the normally open circuit contacts, 3 and 4, close and apply ac to the beam supply simultaneously deenergizing DELAY RELAY K1.

3-24. FUNCTIONAL OPERATION OF THE MECHANICAL COMPONENTS.

Figure 3-5, the electro-mechanical schematic diagram, illustrates the mechanical operation of the Model PMX tuning assembly. The tuning plunger does not mechanically contact the inner and outer conductors. Broadband effective "short-circuit" is achieved by making the choke approximately a 1/4 wavelength at mid-band, keeping the gap between the choke and inner and outer conductors to a practical minimum and using teflon as a bearing surface.

There are two required conditions for proper oscillation. The plunger must be at a predetermined position within the coaxial line and the repeller voltage must be at some proper value within a predetermined repeller mode. The plunger is driven by a cam which corrects for the non-linearity of plunger position with frequency. With a fixed cam, the variation of tuning curve from klystron to klystron would not permit better than an approximately five per cent frequency dial accuracy.

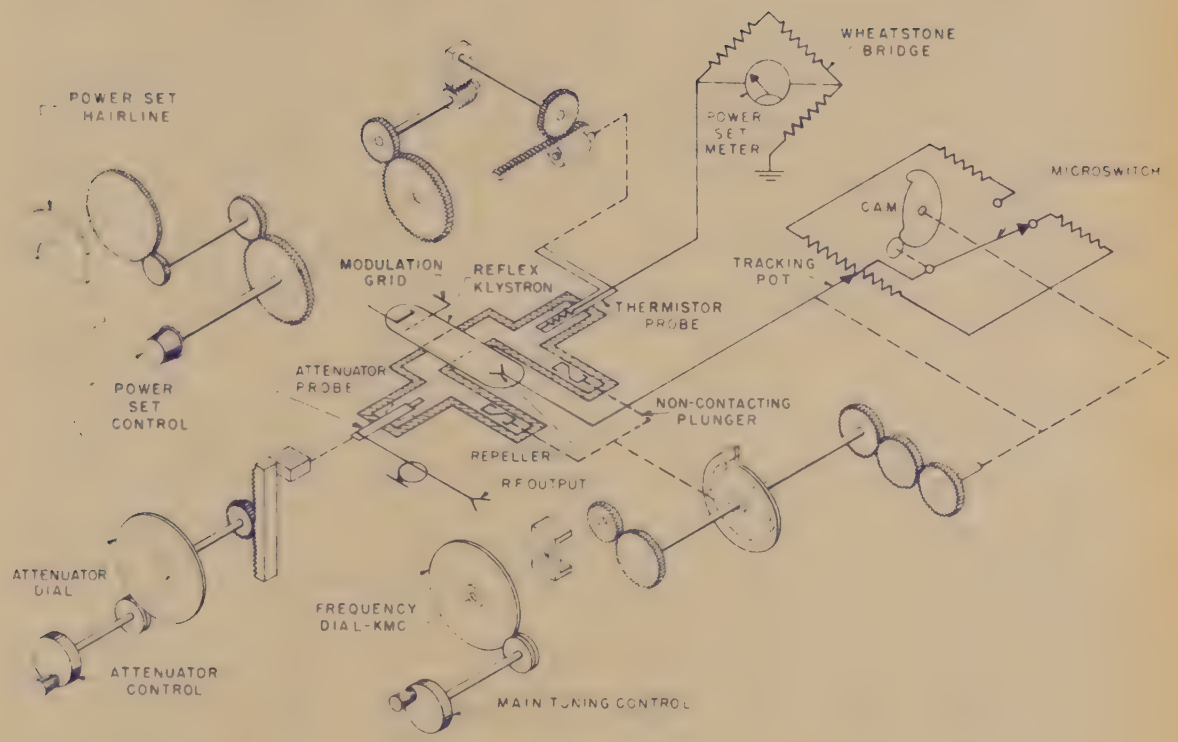


FIGURE 3-5. SIGNAL GENERATOR MODEL PMX, ELECTRO-MECHANICAL SCHEMATIC DIAGRAM.

Frequency dial accuracy, with tube changes, is improved to one per cent by making the cam adjustable through five variable eccentric points. The second requirement for oscillation is obtained by mechanically ganging a tapped potentiometer to the cam shaft that automatically tracks and switches repeller modes. The cavity has two identical waveguide-beyond-cutoff outputs; the guide for the thermistor probe, which is one arm of a Wheatstone bridge and that for the output attenuator. Adjustment of the POWER SET control moves the thermistor probe. The R.F. ATTENUATOR control varies the attenuator probe independently of the thermistor probe.

To calibrate the output attenuator, the Wheatstone bridge is balanced with the rf oscillator off. With the oscillator on, the POWER SET control is adjusted so that the POWER SET meter reads mid-scale. Actual power output can now be read directly from the ATTENUATION -DBM dial. If the rf oscillator is changed to any other frequency, the same calibrated rf output is maintained simply by re-adjusting the POWER SET control so that the meter reads mid-scale. Manual adjustment of frequency is made with the SIGNAL FREQUENCY control.

SECTION 4

MAINTENANCE

4-1. GENERAL.

An understanding of the circuit theory of operation, as described in Section 3, will prove helpful in locating and correcting any defect which may occur. The mechanical drive systems are designed for life-of-equipment operation, and should not be tampered with unless a breakdown occurs. Unnecessary adjustments of the klystron oscillator and calibrated modulator circuit should not be made, since these changes may result in loss of accuracy.

4-2. ACCESS TO THE EQUIPMENT.

To remove the signal generator from its case, set the unit face down. Loosen the knurled screws located at each corner of the rear of the dust cover. Slide the case upward.

To gain access to components located on the subchassis, proceed as follows:

NOTE

When sliding the unit or sub-assemblies out of the frame, ensure that cables are clear of components and chassis.

a. Remove the six machine screws, which secure the modulator front panel to the main frame. Remove connectors P2, P103, P104, and P107 from their sockets to completely disengage the subchassis. Pull the modulator subchassis completely out of the main frame for inspection and testing.

b. Remove the eight machine screws, located on the front panel of the rf and keyer chassis. These screws secure the rf and keyer chassis to the main frame. Remove connectors P1, P2, P103, P104, and P107 from their sockets, to completely disengage the rf and keyer chassis. Withdraw the chassis from the main frame for inspection and testing. Put both the main frame and the rf and keyer chassis back-to-back, and reconnect plugs.

4-3. PRELIMINARY INSPECTION PROCEDURES.

Preliminary inspection comprises a series of operations performed on the signal generator, with the equipment de-energized, to correct conditions which might lead to a breakdown. These breakdowns may be caused by an accumulation of dust and dirt on components and parts or by loose connections and fittings. Table 4-1 lists the preliminary inspection procedure to be performed on the Model PMX, Microwave Signal Generator.

WARNING
OPERATION OF THIS EQUIPMENT INVOLVES THE USE OF HIGH VOLTAGES WHICH ARE DANGEROUS TO LIFE. UNLESS ABSOLUTELY NECESSARY, DO NOT SERVICE OR TEST EQUIPMENT WHEN OPERATING POWER IS APPLIED. USE EXTREME CAUTION IN MAKING ALL VOLTAGE CHECKS. REMOVE POWER AND DISCHARGE ALL CAPACITORS BEFORE TOUCHING THEM. DO NOT TOUCH VACUUM TUBES UNTIL THEY HAVE COOLED, OR SEVERE BURNS MAY RESULT.

TABLE 4-1. PRELIMINARY INSPECTION PROCEDURE

STEP	WHAT TO INSPECT	DEFECTS	REMEDIES	PRECAUTIONS
1	Ac line cord, video cable, and rf cable.	Kinks in the cable, cuts, deteriorations, and fraying of the rubber insulation.	Replace the cable, if necessary.	Make sure that proper type and length of cabling is used.
		Loose connectors.	Tighten or resolder connections, or replace cable.	
		Dirt, oil, grease, corrosion.	Clean with lint-free cloth moistened with carbon tetrachloride; then wipe dry.	CAUTION: Repeated contact of carbon tetrachloride with skin or prolonged breathing of fumes, is dangerous. Make sure adequate ventilation is provided.
2	Power Set meter.	Bent indicator, cracked or broken glass.	Replace the meter, if necessary.	
3	Knobs, screws, connectors, and handles.	Looseness.	Tighten.	Tighten carefully, so as not to damage screws on equipment.
4	Switches.	Inability to change positions or evidence of slipping.	Replace all defective switches.	

TABLE 4-1. PRELIMINARY INSPECTION PROCEDURE (continued)

STEP	WHAT TO INSPECT	DEFECTS	REMEDIES	PRECAUTIONS
5	Rear of panel and chassis.	Dirt, corrosion, moisture, and rust.	Remove loose dirt and dust with a brush or low air pressure. Remove dirt and grease on the chassis or panel with a brush or cloth dipped in carbon tetrachloride.	
6	Mounting screws and clamps.	Looseness	Tighten	Do not tighten slotted shafts of variable resistors.
7	Solder joints.	Loose or cold soldered joints and corroded joints.	Resolder, clean and resolder.	
8	Capacitors.	Leaks, bulges, and signs of discoloration	Replace capacitor	
9	Pilot lights.	Jewel cracked, broken or missing, light does not operate .	See that all lamps are operating. Replace burned out lamps. Replace missing, broken or cracked jewel.	

TABLE 4-1. PRELIMINARY INSPECTION PROCEDURE (continued)

STEP	WHAT TO INSPECT	DEFECTS	REMEDIES	PRECAUTIONS
10	Tubes, except for reflex klystron.	Poor seating.	Press tubes firmly into sockets.	Never work on tubes immediately after shutdown, severe burns may result. Do not jiggle tubes or partially withdraw them from sockets. Such movements tend to weaken tube pins and spread the contacts in the socket. Do not check the reflex klystron tube.
11	Tube shields, except for reflex klystron.	Looseness. Missing shields.	Press tube shields firmly into position. Replace missing shields.	
12	Tube sockets.	Looseness. Cracks, chips.	Tighten mounting screws. Replace socket, if necessary.	
13	Oscillator drive.	Catching or Jamming when SIGNAL FREQUENCY knob is rotated. Dust, dirt or foreign matter in oscillator gear box or on oscillator drive shaft. Bent or broken teeth on gears.	Clean. Remove all foreign matter. Return to manufacturer or obtain replacement.	CAUTION: Do not drive oscillator in any way other than by its control knob. Do not interfere in any way with the operation of the gear mechanism while the control is being turned. Never use force.

TABLE 4-1. PRELIMINARY INSPECTION PROCEDURE (continued)

STEP	WHAT TO INSPECT	DEFECTS	REMEDIES	PRECAUTIONS
14	Thermistor and Attenuator Drive Assembly.	Catching or jamming when either the R.F. ATTENUATOR or POWER SET controls are turned. Dust, dirt or foreign matter.	Remove dirt and foreign matter with a brush or lintfree cloth dipped in carbon tetrachloride.	CAUTION: Refer to caution for Oscillator Drive (step 13) and AC line cord (step 1).
15	Air filter needs Cleaning and re-oiling.	Appears dirty or clogged.	Clean with carbon tetrachloride. Dip into a mixure of 1 part SAE No. 30 oil and 3 parts thinner. Shake out and wipe fan blades.	

4-4. TROUBLE SHOOTING.

Table 4-2 lists the trouble shooting procedure for localizing a defect to a particular circuit. Figures 4-1 and 4-2 show the right and left views of the complete unit. Figure 4-3 is a top view of the Low Voltage Power Supply showing the location of components, and figure 4-4 is a view showing the components located on the underside of the chassis. Figure 4-5 is a component layout of the modulator section of the equipment which will aid in locating components. Figures 4-6 and 4-7 are photographs of the top and bottom of the Repeller and Beam Chassis, respectively, showing the location of components. Figure 4-8 is an overall view of the RF and Keyer Supply showing the location of adjustments, components, and test jacks.

NOTE

Do not disturb any preset adjustments unless the trouble is definitely caused by a chassis adjustment control.

As the first step in any trouble shooting, check the power supplies, and relays K101 and K103, for proper operation. It is advisable to follow Table 4-2, the trouble shooting chart, step by step during trouble shooting of the unit.

Figure 4-1. Microwave Signal Generator Model PMX, Side View Right

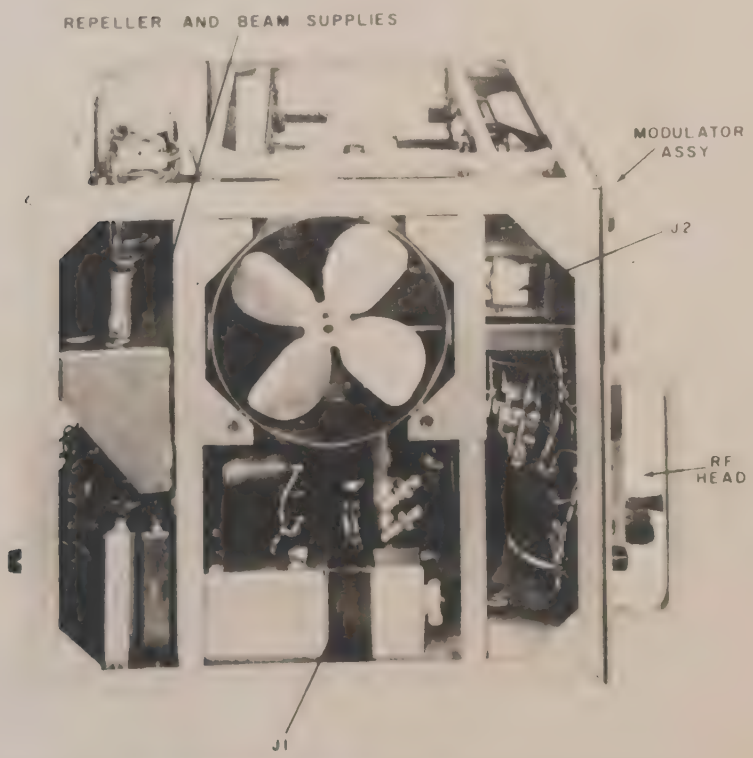


Figure 4-2. Microwave Signal Generator Model PMX, Side View Left

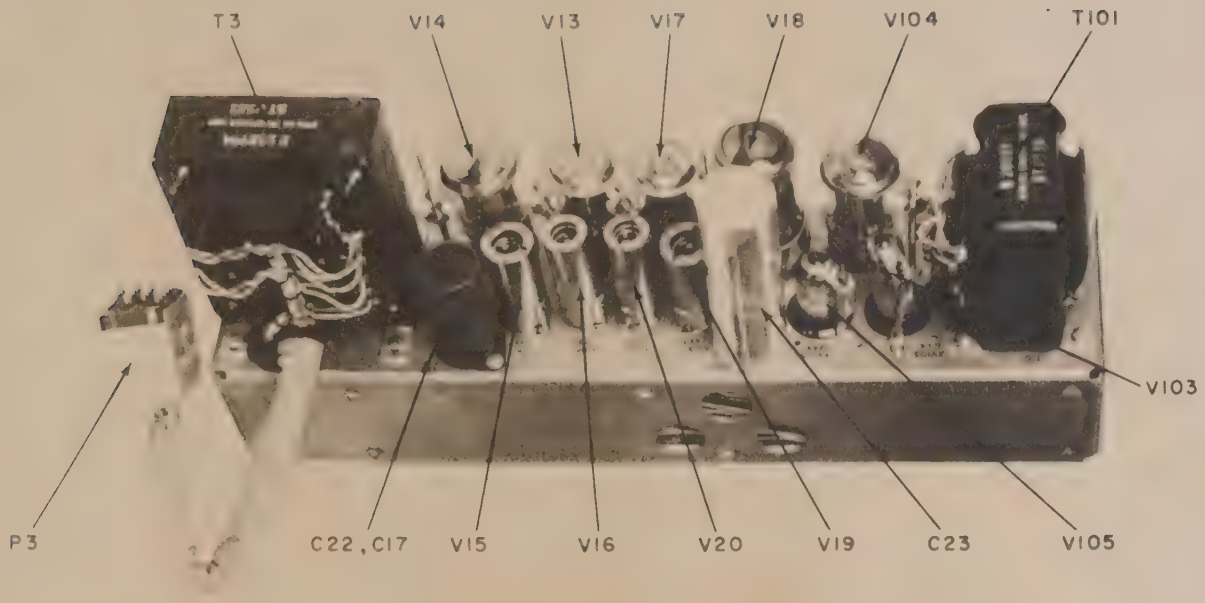


Figure 4-3. Low Voltage and Keyer Power Supply, Top View

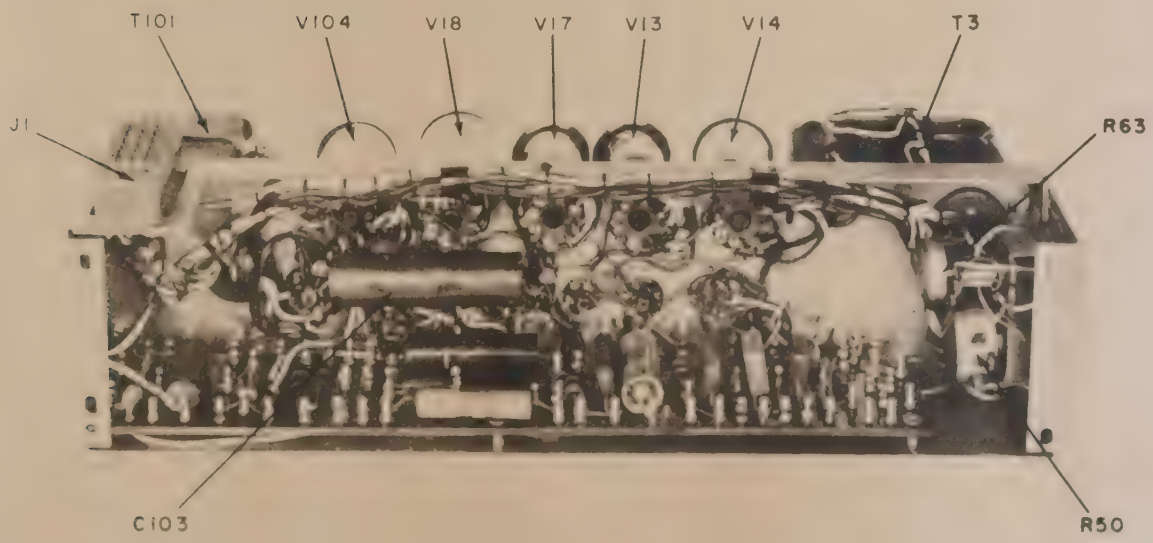


Figure 4-4. Low Voltage and Keyer Power Supply, Bottom View

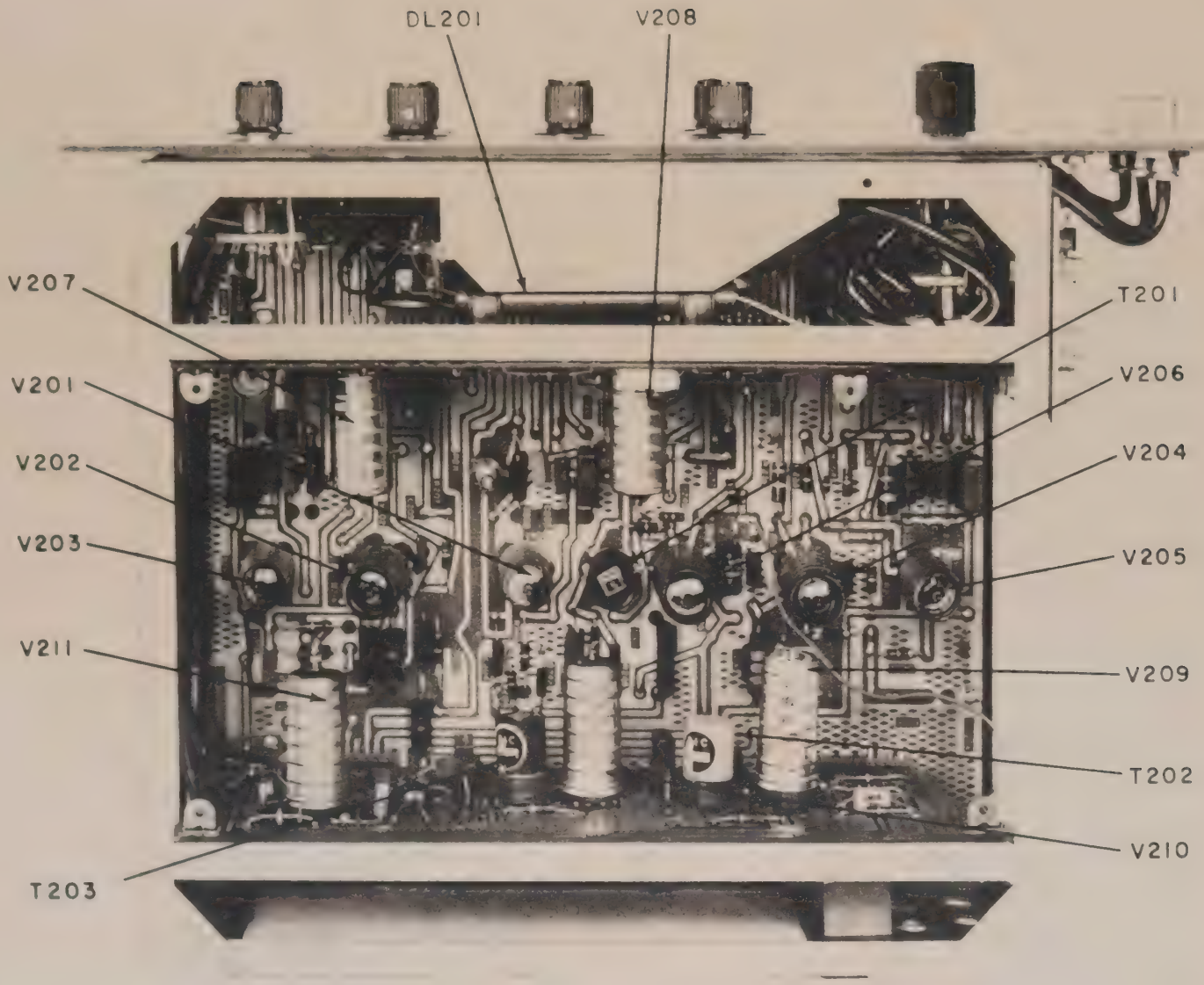


Figure 4-5. Modulator Assembly, Component Layout

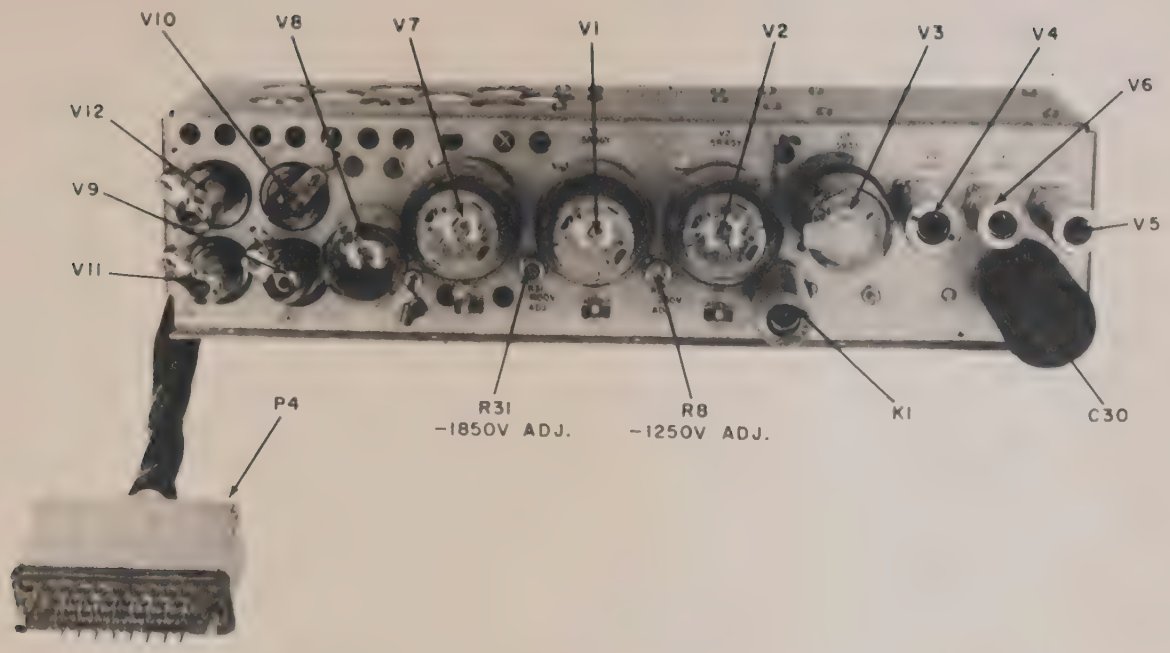


Figure 4-6. Repeller and Beam Chassis, Top View

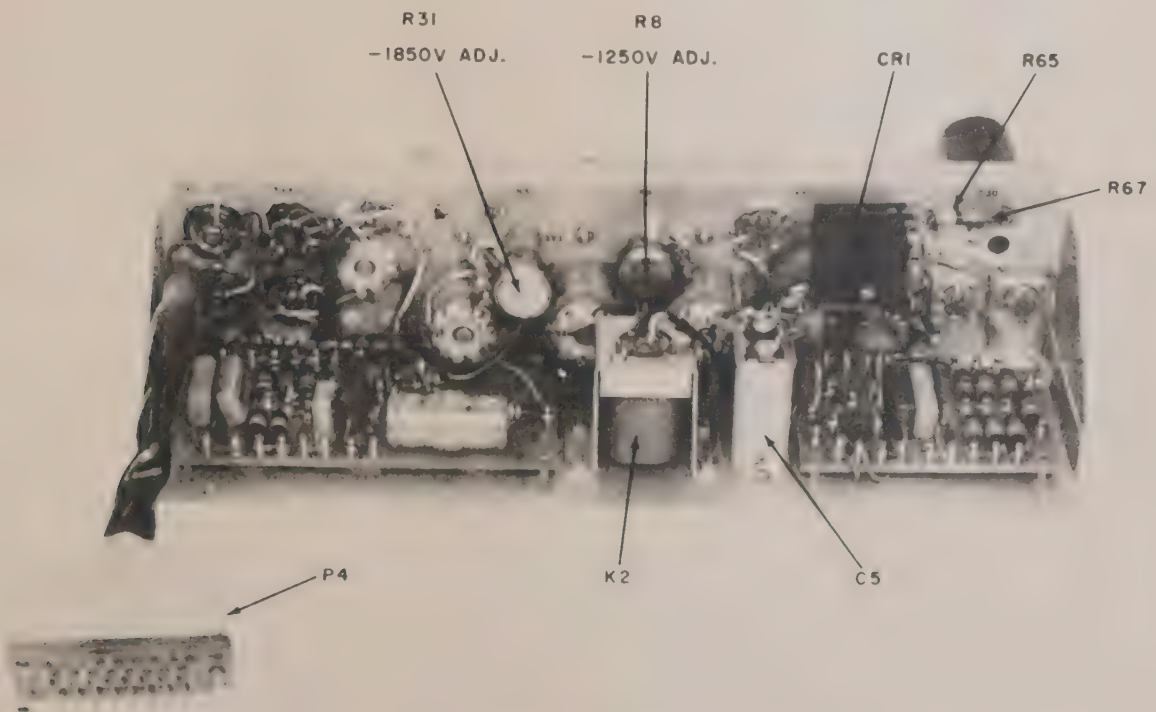


Figure 4-7. Repeller and Beam Chassis, Bottom View

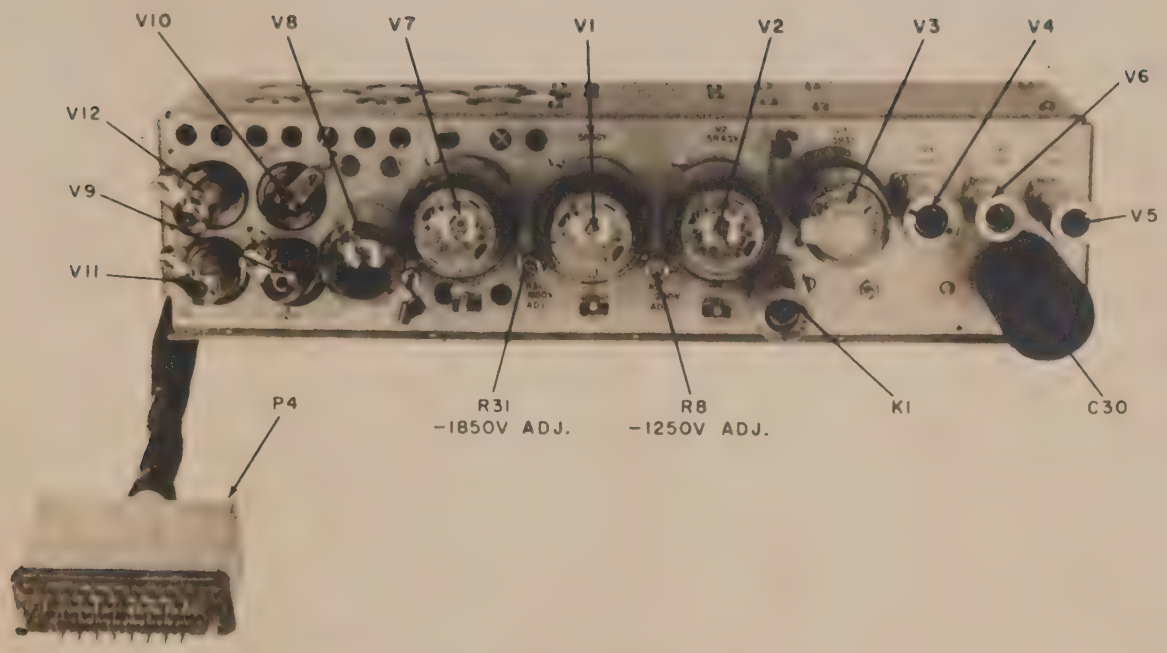


Figure 4-6. Repeller and Beam Chassis, Top View

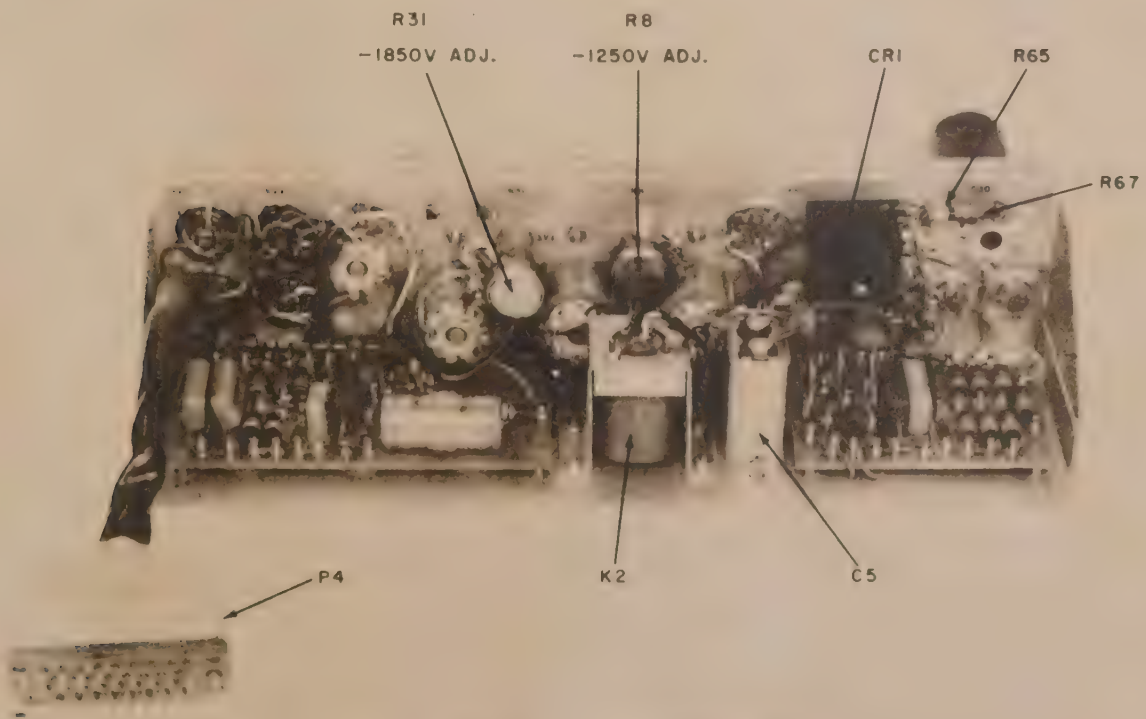


Figure 4-7. Repeller and Beam Chassis, Bottom View

TABLE 4-2. TROUBLE SHOOTING

STEP	SYMPTOM	PROBABLE CAUSE	POSSIBLE REMEDY
1	Instrument not operating.	Blown line fuses.	Replace.
2	Low operating voltages.	115-230v switch in wrong position.	Place in proper position.
3	No repeller voltage -600 volts.	RECTIFIER V7, SERIES REGULATOR V8.	Replace if defective.
4	Repeller voltage high, no regulation.	D.C. AMPLIFIER V9.	Replace if defective.
5	No -1250V beam voltage.	RECTIFIER V1, RECTIFIER V2, SERIES REGULATOR V3, DELAY RELAY K1 or HOLD RELAY K2.	Replace if defective.
6	Beam voltage high, no regulation.	D.C. AMPLIFIER V4.	Replace if defective.
7	No +210 volts.	RECTIFIER V17, SERIES REGULATOR V18.	Replace if defective.
8	+210 volts high, no regulation.	D.C. AMPLIFIER V19.	Replace if defective.
9	No -108 volts.	RECTIFIER V13, SERIES REGULATOR V14.	Replace if defective.
10	-108 volts high.	D.C. AMPLIFIER V15.	Replace if defective.

STEP	SYMPTOM	PROBABLE CAUSE	POSSIBLE REMEDY
15	No output when MODULATION SELECTOR switch is in INT. PULSE, INT. SQ. WV. or FM positions.	+210v power supply and -108 power supply.	Refer to steps 7, 8, 9, and 10.
	In the following modulation trouble shooting conditions, it is assumed that the klystron oscillator is operating satisfactorily in CW. If not, see the above trouble shooting procedure.		
16	(a) When MODULATION SELECTOR switch is in FM position and SYNC & POLARITY switch is in INT. MOD. & SQ. WV. position, no rf FM output is available.	PHANTASTRON RATE GEN V201, COUPLING AMPL V202, PHANTASTRON RATE GEN V203, and FM AMPLITUDE control R201. Check FM J107 for sawtooth waveform output.	Replace defective tubes or components.
	(b) No rf FM output available when using external sync.	PHASE INVERTER V207A, CLIPPER AMPL V207B and/or SCHMITT TRIGGER V208. Check CR208 and items mentioned in part (a).	Replace defective tubes or components.
17	(a) No rf pulse available when MODULATION SELECTOR switch is in INT. PULSE position and SYNC & POLARITY SELECTOR switch is in INT. MOD. & SQ. WV. position.	Check CR101, 102, 104, and 105. Check all tubes in the Modulator section except V207 and V208. Check C107 and C108 and SET and RESET receptacles respectively.	Replace where defective. (See theory section and block diagram. Replace where defective.
	(b) No rf pulse output available when using external sync.	Check as in part (a) and include V207, V208, and R238.	Readjust R238 if necessary. (See paragraph 5-8).

TABLE 4-2. TROUBLE SHOOTING (continued)

STEP	SYMPTON	PROBABLE CAUSE	POSSIBLE REMEDY
18	Unable to vary pulse width when MODULATION SELECTOR switch is in INT. PULSE position.	WIDTH MULTIVIBRATOR V211, MIN WIDTH ADJ R315, and PULSE WIDTH MICROSECONDS R316.	Readjust R315 or replace defective parts. (See paragraph 5-9).
19	(a) No rf square wave available when MODULATION SELECTOR switch is in INT. SQ. WV. position and SYNC & POLARITY SELECTOR switch is in INT. MOD. & SQ. WV. position.	See step 17. Check triggers at SET J104 and RESET J103. Trigs gers should be at 50% points.	(See theory of operation and block diagram.)
	(b) Poor symmetry in SQ. WV. operation.	SQ. WV. SYMMETRY ADJ. R211 misaligned.	Realign R211 or replace if defective. (See paragraph 5-7.)
20	Klystron oscillator cannot be externally modulated with either a positive or negative signal.	AMPLIFIER V107, AMPLIFIER V108 or PHASE INVERTER V109.	Replace where defective.
21	PRF range cannot be covered in FM, INT. PULSE or INT. SQ. WV. operation	FREQUENCY CYCLES PER SECOND control R212 and LOW FREQ. ADJ. R217.	(See adjustments procedures, paragraph 5-6.)
22	DELAY range cannot be obtained in internal and external sync.	MIN DELAY ADJ R233, DELAY MICROSECONDS control R234.	(See adjustment procedures paragraph 5-8.)

TABLE 4-2. TROUBLE SHOOTING (Continued)

STEP	SYMPTOM	PROBABLE CAUSE	POSSIBLE REMEDY
23	No UNDELAYED SYNC pulse in internal operation.	PHANTASTRON RATE GEN V201, COUPLING AMP V202, and PHANTASTRON RATE GEN V203.	Replace where defective.
24	No DELAYED SYNC pulse in internal operation.	BLOCKING OSCILLATOR V206A, DELAYED SYNC BLOCKING OSCILLATOR V206B, 0.8 usec Delay Line DL202, T201, DELAYED SYNC OUT receptacle J204.	Replace where defective.
		DELAY PHANTASTRON V205, CATHODE FOLLOWER V204A, BUFFER AMPL V204B and the tubes mentioned in step 23.	Replace where defective.

4-5. CHECKING THE DC POWER SUPPLIES

The dc voltages, required for proper signal generator operation, are obtained from five electronically regulated power supplies; the beam supply, the repeller supply, the keyer supply, the modulator supply, and the +210V power supply. Refer to section 3 for a detailed discussion, and to figure 5-7 for a complete schematic diagram.

In the event a power supply does not give the normal indication called for in table 4-3 (Power Supply Voltages), refer to table 5-1 (Adjustments, Power Supplies) and to figures 4-3, 4-4, 4-6, 4-7, and 4-8 to locate the defective component in the supply.

TABLE 4-3. POWER SUPPLY VOLTAGES

POWER SUPPLY	TEST POINTS		VOLTS
	FROM	TO	
Beam	C6	Ground	-1250
+210V	Pin 1, 5 of V20	Ground	+210
Repeller	Across C16 C16 Junction of R141 and R142 Pin 7 of V107	Ground Ground Ground	-600 or -1850 -1550 -1400
Modulator	Pin 2,4,7 of V16	Ground	-108
Keyer	Across C106		150 to 170

4-6. CHECKING RELAYS K101 and K102.

The rotation of MODULATION SELECTOR switch S203 to its various positions will cause relays K101 and K102 to energize. Table 4-4 (Relays Energized) indicates which relays will be energized at the various positions of the MODULATION SELECTOR switch. If indications of abnormal operation are present check the relays for dirty or bent contacts.

TABLE 4-4. RELAYS ENERGIZED

MODULATION SELECTOR POSITION	RELAY K101	RELAY K102
EXT. MOD	Energized	
INT. PULSE		
INT. SQ. WV.		
FM		Energized
CW		Energized
ZERO SET	Energized	Energized

4-7. REPLACEMENT OF RF KLYSTRON OSCILLATOR.

WARNING
This equipment employs high voltages which are dangerous to life. Do NOT attempt to replace the reflex klystron oscillator tube unless the power cord is disconnected from the power input receptacle J1. For access to the equipment, see paragraph 4-2.

a. Removing The Klystron Cover And Klystron Tube. (See figure 4-9.)

1) Loosen clamp strap around klystron cover.

2) While holding klystron cover in one hand, GENTLY pull the tube socket away from the base of the klystron.

3) Use the spanner wrench supplied with the signal generator to loosen the klystron clamp (knurled silver-plated nut), which is threaded to the tuned cavity. DO NOT REMOVE THE KNURLED NUT COMPLETLY. A half turn counterclockwise is sufficient to release its locking action.

4) Grasp the projecting end of the klystron tube, gently rotating it in a clockwise direction while simultaneously withdrawing the tube from its spring-finger holder within the cavity.

5) Carefully insert a replacement 5721 klystron tube, known to be in good operating condition, into the cavity, and press it all the way in, making sure the repeller cap makes firm contact with the inner conductor.

6) Use the spanner wrench to tighten the klystron clamp nut. DO NOT EXERT PRESSURE.

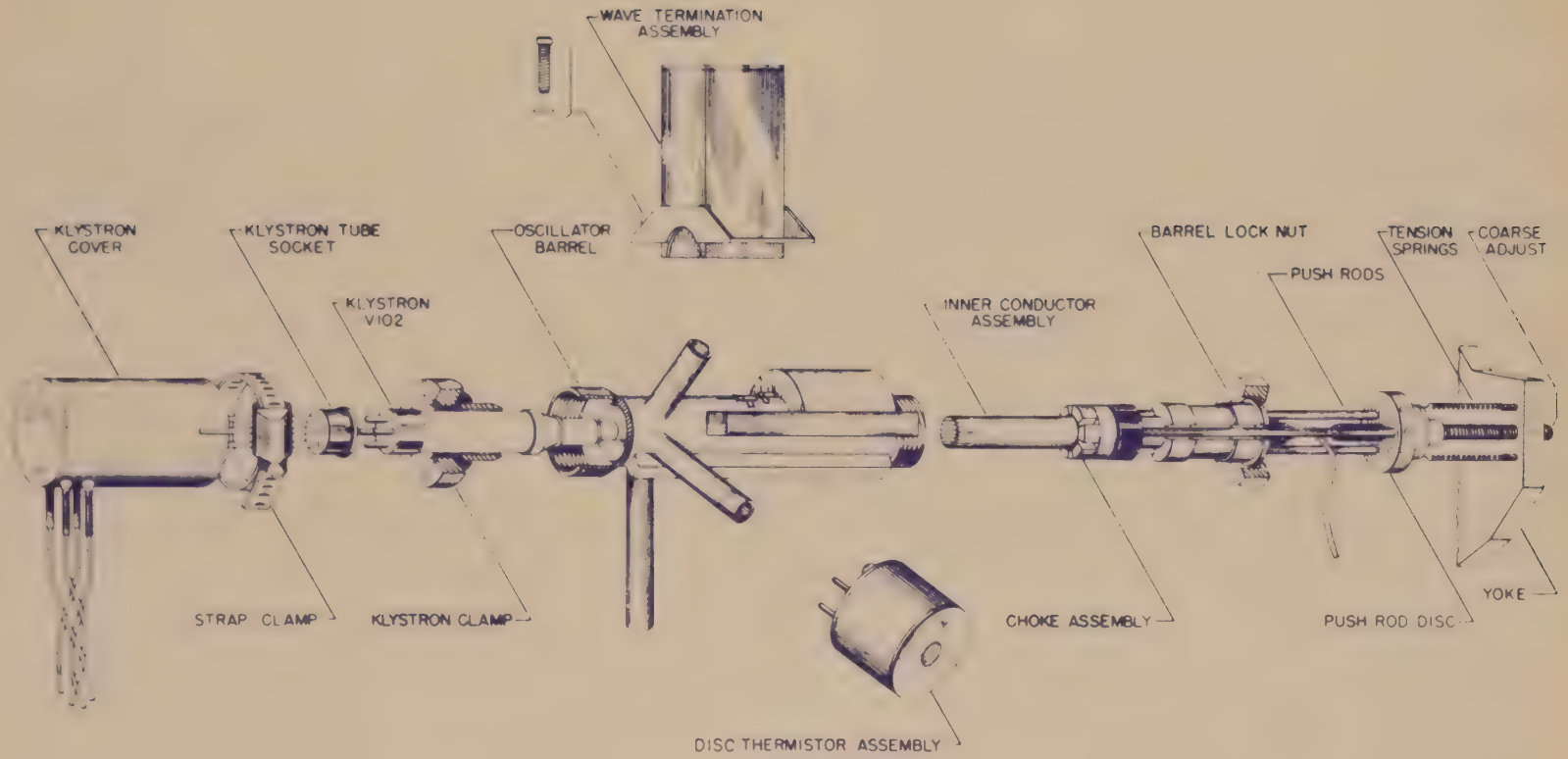


FIGURE 4-8. OSCILLATOR CAVITY, EXPLODED VIEW

b. Reassembling The Klystron Cover.

1) Attach the tube socket to the base of the klystron tube. Ensure that the proper tube socket pins are engaged, since this minature socket may be easily forced into an improper position which will result in the application of improper voltages to the klystron tube.

2) Slide the klystron cover over the socket until the klystron clamp nut is covered. Tighten clamping strap to secure the shield.

3) After replacing the klystron oscillator tube, certain adjustment and alignment procedures must be performed. Refer to table 5-1 for the adjustment of BEAM CURRENT ADJ R127, to paragraph 5-3 for the repeller tracking voltage adjustment and alignment, and to paragraph 5-5 for the frequency dial calibration.

SECTION 5

ADJUSTMENT AND ALIGNMENT

WARNING

OPERATION OF THIS EQUIPMENT INVOLVES VOLTAGES WHICH ARE DANGEROUS TO HUMAN LIFE. REMOVE POWER AND GROUND CIRCUITS BEFORE TOUCHING THEM.

5-1. POWER SUPPLY ADJUSTMENTS.

The procedure for checking and adjusting the outputs of the various power supplies is given in table 5-1(Adjustments, Power supplies). See figures 4-3 through 4-8 for location of adjustment controls, components, and test points.

CAUTION

The BEAM CURRENT ADJ R127, in the Keyer Supply is factory adjusted and should not be readjusted except when changing the klystron tube or during trouble shooting. Misalignment of this control can cause severe damage to the klystron tube.

5-2. 115-230V SWITCHING SYSTEM.

The 115V-230V input switching system of the unit is normally factory set at 115 volts. If it is desired to use 230 volts as input to the equipment, the internal input switching system must be set as follows:

a. Remove the dust cover as described in paragraph 4-2.

b. The 115-230V switch is a two position switch marked 115-230V. It is located on the basic unit.

c. Simply place the switch in the desired position.

TABLE 5-1. ADJUSTMENTS, POWER SUPPLIES

CIRCUIT	TEST POINTS	TEST EQUIPMENT	NORMAL INDICATION	ADJUSTMENT PROCEDURE
Beam Supply	1	DC voltmeter	-1250	Adjust -1250V ADJ R8. If indication is abnormal, refer to paragraph 3-2 for the theory of operation.
+210V Supply	2	DC voltmeter	+210 volts	Adjust +210V ADJ R63. If indication is abnormal, refer to paragraph 3-6 for the theory of operation.
Repeller Supply	3	DC voltmeter	-1850 volts	Adjust -1850V ADJ R31. If indication is abnormal, refer to paragraph 3-3 for the theory of operation.
Keyer Supply	4	DC voltmeter	+1 volt across R5 with MODULATION SELECTOR switch in CW position.	See paragraph 5-1 CAUTION notice. Adjust BEAM CURRENT ADJ R127. If indication is abnormal, refer to paragraph 3-4 for the theory of operation.
Modulator Supply	5	DC voltmeter	-108 volts	There is no adjustment for this supply. Its normal output is 108 volts. It is possible, however, to misalign COURSE ADJ R50 to lower the output.

TABLE 5-1. ADJUSTMENT, POWER SUPPLIES (continued)

CIRCUIT	TEST POINTS	TEST EQUIPMENT	NORMAL INDICATION	ADJUSTMENT PROCEDURE
Bridge Circuit	None	None	Meter M1 can be set to ZERO with MODULATION SELECTOR switch in ZERO SET position	Allow signal generator to remain de-energized for at least one hour. Energize the signal generator and rotate ZERO SET control to its full clockwise position. Adjust COURSE ADJ R50 until the POWER SET meter goes to max. full scale deflection. If indication is abnormal refer to paragraph 3-8 for the theory of operation.

5-3. REPELLER VOLTAGE TRACKING PROCEDURE.

Due to the variations in klystron tube characteristics, replacement of the tube will usually require readjustment of the repeller tracking voltages. The repeller voltage tracking procedure assumes that the unit was previously aligned and operating, but that the klystron was changed. The repeller voltages are first adjusted for proper mode trace on the oscilloscope in CW operation, and then in pulse-modulated output. The equipment needed to perform the above is listed in table 5-2.

TABLE 5-2. TEST EQUIPMENT REQUIRED FOR REPELLER TRACKING PROCEDURE.

FREQUENCY RANGE	OSCILLOSCOPE	COAXIAL CRYSTAL MOUNT	REACTION TYPE FREQUENCY METER ACCURACY OF 0.1% OR BETTER	COAXIAL-TO-WAVEGUIDE ADAPTER
4.45 to 5.85 KMC	Dumont 304A	HP420A	PRD-574 3.95 - 5.85 KMC	PRD-357
5.85 to 8.20 KMC	Dumont 304A	HP420A	HP-J530A 5.85 - 8.20KMC.	HP-J281A
8.20 to 11.0 KMC	Dumont 304A	HP420A	HP-X530A 8.20 - 12.4 KMC	HP-X281
ADJUSTMENT OF THE REPELLER TRACKING CIRCUIT DURING INT. PULSE MODULATION REQUIRES THE USE OF THE FOLLOWING EQUIPMENT.				
4.45 to 11.0 KMC	Tektronix 531A	HP420A	As above for the various ranges.	As above for the various ranges.

a. Test Set-up.

1) Remove the rf chassis from the main frame as described in paragraph 4-2 and connect all plugs. PROCEED WITH CAUTION. Set up the equipment while operating power is disconnected. See figure 5-1 for this test set-up. The Modulator Phase Shifting Circuit MK-1 is not supplied with this equipment. It can be fabricated from the schematic diagram, figure 5-2, or purchased from Polarad Electronics Corporation.

2) Connect one end of the coaxial crystal mount, with dc return to the vertical input of a high gain oscilloscope, and the opposite end to the coaxial-to-waveguide adapter.

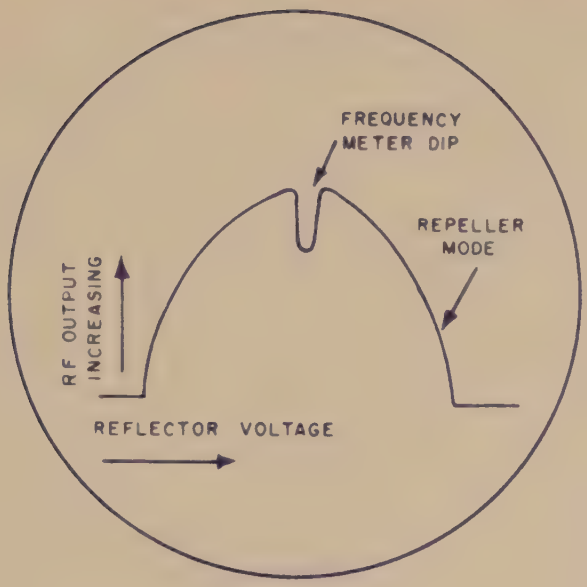
3) Connect a coaxial-to-waveguide adapter to the signal generator and place a reaction type frequency meter having an accuracy of 0.1% or better, between the two adapters.

4) See table 5-2 for the equipment required at the different frequency ranges.

b. Control Settings for Model PMX.

1) With MODULATION SELECTOR switch S203 at its CW position, apply operating power to the signal generator and allow at least a 20-minute warmup period.

2) Rotate SYNC & POLARITY SELECTOR switch S201 to its INT. MOD. & SQ. WV. position.



TYPICAL MODE TRACE

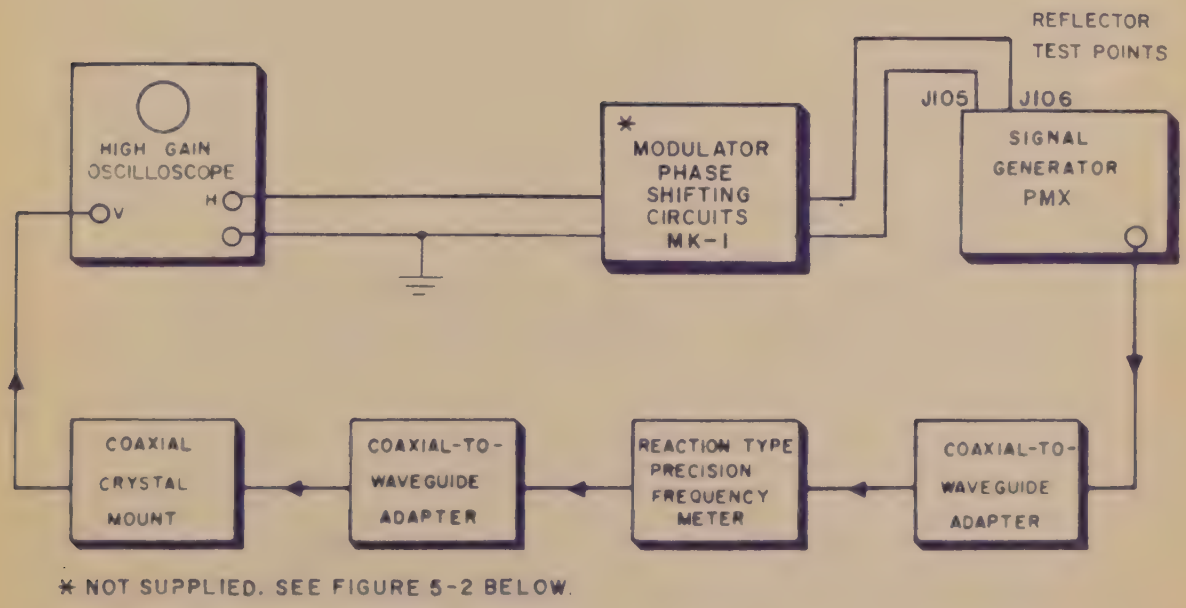


FIGURE 5-1. REPELLER VOLTAGE TRACKING, TEST SET-UP.

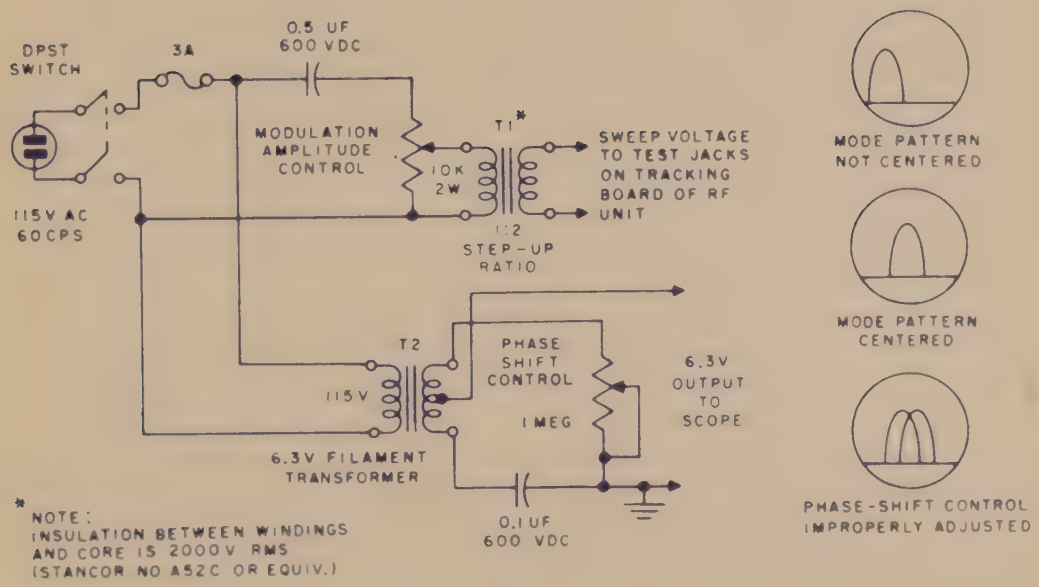


FIGURE 5-2. MODULATOR PHASE SHIFTING CIRCUIT, MK-1, SCHEMATIC DIAGRAM

d. Track Potentiometer Adjustments (CW)

1) After the test equipment has been set up and the controls set as directed in the preceeding steps, connect the negative lead of a 20,000 ohm-per-volt voltmeter to the repeller connection J105, and the positive lead to pin 3 of TRACKING POT R101 and proceed as directed in table 5-3.

TABLE 5-3. TRACKING ADJUSTMENTS.

STEP	X-40 Head SET FREQUENCY DIAL TO:	INDICATION VOLTAGE*	INDICATION MODE	IF INDICATION IS NOT CORRECT, ADJUST:
1			2-3/4	LOW POT. R102
2			2-3/4	TRACK 1 and 2 R103, R104
			2-3/4	TRACK 2 R104
			2-3/4	LOW MODE POT. R107
			2-3/4	LOW MODE POT. R107
			4-3/4	HIGH MODE POT., TRACK 3, R106, R104
			4-3/4	TRACK 3 R105
			4-3/4	TRACK 3 R105
			4-3/4	HIGH POT. R106
			3-3/4	LOW POT. R102
			3-3/4	TRACK 2, TRACK 3, R104, R103
			-3/4	TRACK 2 R104
			3-3/4	LOW MODE POT. R107
			4-3/4	HIGH MODE POT. R106
			4-3/4	TRACK 3 R105
			4-3/4	TRACK 3 R105
			4-3/4	TRACK 3
			4-3/4	HIGH POT. R106

* Approximate. There may be a variation of ±10% due to the difference in klystron tubes.

2) Recheck the repeller voltages at the high and low dial frequencies by repeating steps 1 and 2 of table 5-3. Upon completion, check the intermediate tracking points.

NOTE
If the klystron has been replaced, the above procedure should afford correct repeller tracking. Failure to track properly may indicate a defective replacement klystron.

3) The repeller voltage must now be rechecked, as directed above (step 2), because of the interacting effects of the adjustments. Minor adjustments are to be made, as necessary, to complete the alignment procedure, with the signal generator producing continuous-wave output signals.

e. Track Potentiometer Adjustments (Pulse-Modulated Output).

Recheck the repeller voltage tracking throughout the tuning range as follows:

1) Rotate MODULATION SELECTOR switch to its INT. PULSE position.
2) Set SYNC & POLARITY SELECTOR switch to its INT. MOD. & SQ. WV. position.
3) Set FREQUENCY MULTIPLIER and FREQUENCY CYCLES PER SECOND controls to produce a pulse repetition frequency of approximately 1,000 pps.
4) Check for pulse-modulated output throughout the equipment frequency range.

5-4. TRACKING ADJUSTMENT AFTER REPLACEMENT OF TRACK POTENTIOMETER.

After the replacement of one of the track potentiometers, R102 through R106, set the arm of the replacement potentiometer to the center of its travel and proceed as directed in paragraph 5-3.

NOTE

If trouble is experienced in the alignment of the repeller tracking circuit, it may be localized by measuring the voltage between tests points J105 and J106. The voltage should be 600 volts dc.

5-5. FREQUENCY DIAL CALIBRATION.

a. Perform the test set-up as described in paragraph 5-3A, using the test equipment indicated in table 5-2. If the accuracy of the frequency dial falls outside the 1% tolerance at any pont over the tuning range, fine adjustments can be made by means of the adjustable tuning cam shown in figure 5-3. Five eccentric bolts and nuts on the cam are to be adjusted as described below:

1) Turn the SIGNAL FREQUENCY control so that the cam follower is at a fixed section of the tuning cam adjacent to the two small holes which terminate the arc on the cam. Tune the wavemeter to 7480 mc. The FREQUENCY IN MEGACYCLES dial will be at this frequency.

2) A mode pattern should appear on the oscilloscope. A dip should appear at the center of the mode pattern if the oscillator output is at 7840 mc.

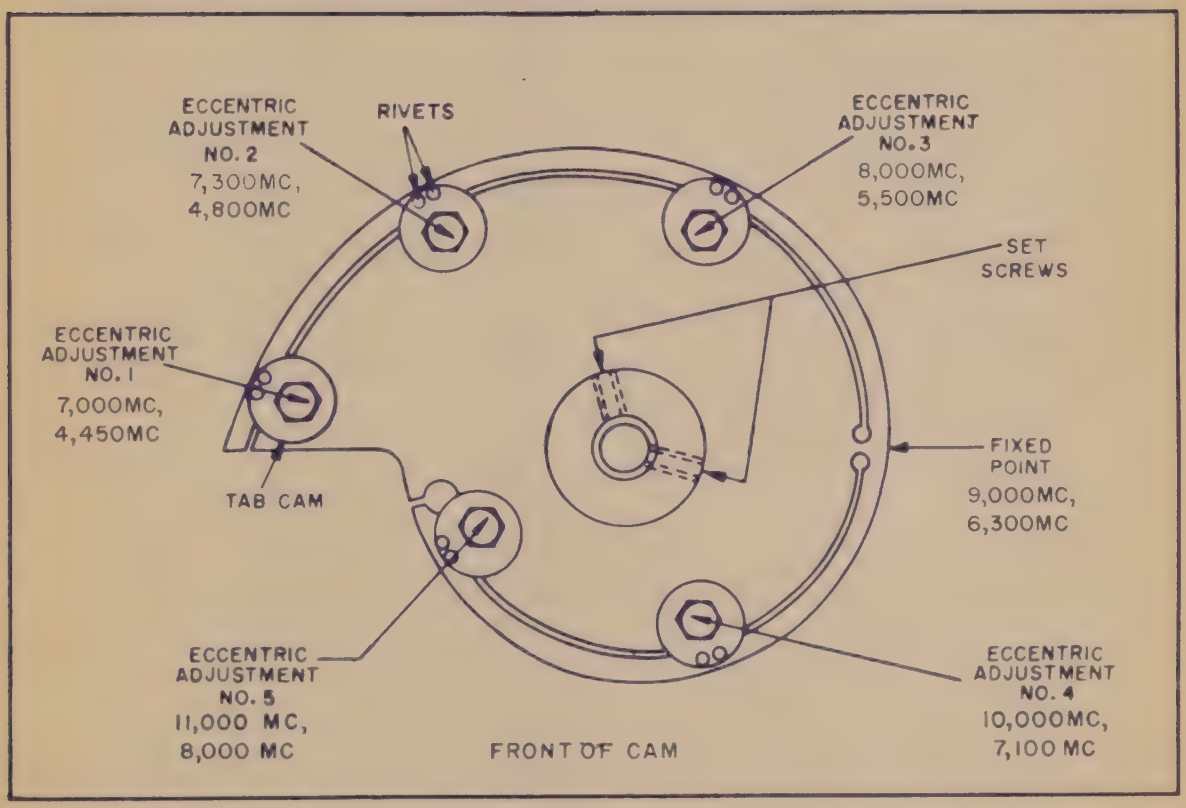


Figure 5-5. Oscillator Adjustable Tuning Cam, Component Location Diagram (frequency adjustment [illegible]nt, for the G[illegible] and G711 RF Heads).

WARNING

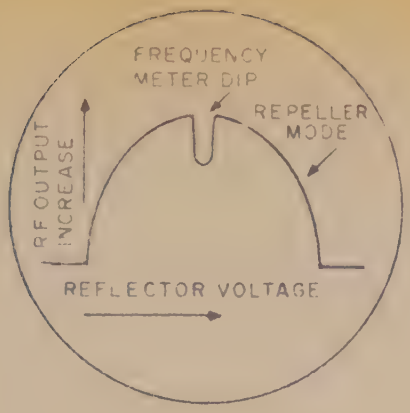
WHEN SERVICING CARE SHOULD BE EXCERCISED IN ADJUSTING THE ATTENUATOR AND THERMISTOR PROBES. FORCIBLY PUSHING THE PLUNGER FORWARD BEYOND ITS NORMAL MECHANICAL STOP WILL CAUSE SEVERE DAMAGE TO THE INTERNAL KLYSTRON CAVITY THEREBY DISTROYING THE OVER-ALL CALIBRATION OF THE EQUIPMENT.

3) Frequency correction is made by adjusting the push-rods which are part of the choke assembly. This is the ONLY time the push-rods will be adjusted. Use the Spline wrench, supplied, to loosen the three set-screws on the push-rod disc. (See figure 4-9.) GENTLY and SLOWLY move the push-rods up or down so that the oscillator frequency changes enough to move the dip to the center of the mode pattern as shown in figure 5-4. Once the dip is centered, a reference point has been established on the cam with respect to the dial. Tighten the set-screws after this has been accomplished. Recheck for dip centering on the mode pattern.

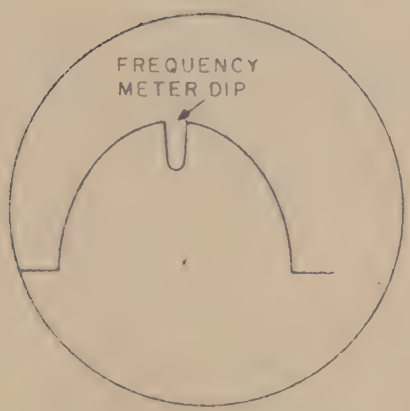
4) Next, the remainder of the oscillator frequency range is calibrated. This is accomplished by using the five adjustment bolts located along the periphery of the cam. (See figure 5-3.) Since the bolts are off-set, adjusting them slightly alters the shape of the periphery of the cam.

CAUTION

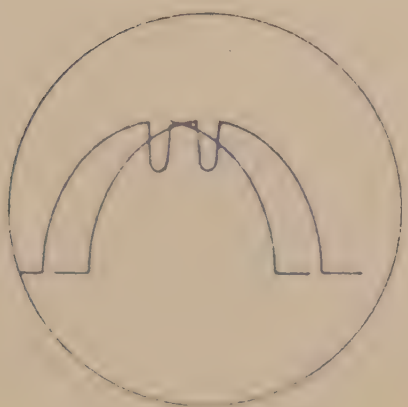
NEVER ATTEMPT TO ADJUST ANY BOLT ON THE TUNING CAM UNLESS ALL THE BOLTS ON THAT SECTION OF THE CAM ARE FIRST LOOSENED. FAILURE TO OBSERVE THIS PRECAUTION WILL RESULT IN STRIPPING THE RIVETS THAT SECURE THE TAB CAMS TO THE CAM.



MODE PATTERN CENTERED



MODE PATTERN NOT CENTERED



PHASE SHIFT CONTROL
IMPROPERLY ADJUSTED

Figure 5-4. Mode Patterns

5) Rotate the SIGNAL FREQUENCY control until the FREQUENCY IN MEGACYCLES dial indicates 9540 mc. The cam follower will be directly opposite eccentric adjustment no. 4.

6) To determine the oscillator frequency, set the wavemeter to the above frequency. If the wavemeter dip is not in the center of the mode pattern, adjusting the bolts will shift the mode pattern slightly.

7) This procedure is repeated at each of the five adjustment bolts as listed below in the following order:

Tuning Head G-711

2nd step: Eccentric No. 5 -
3rd step: Eccentric No. 3 -
4th step: Eccentric No. 2 -
5th step: Eccentric No. 1 -

Tuning Head G-48

2nd step;
3rd step:
4th step:
5th step:

8) After making each adjustment, tighten each cam nut using two open-end wrenches. Both the hexhead nuts and bolts are 5/16 inches wide across the flats.

9) After the last adjustment has been made, recheck the previous four adjustments to be sure that they have not been disturbed by subsequent adjustments. Upon completion, check the calibration of the oscillator at 25 megacycle intervals throughout the entire frequency range. If all points are within 0.5% of the wavemeter readings, the oscillator is correctly calibrated.

5-6. SETTING THE LOW FREQ. ADJ. R217.

a. Connect the signal generator and test equipment as shown in figure 5-5A. Energize the equipment and allow a fifteen minute warm-up period.

b. Set FREQUENCY MULTIPLIER control to X10 position.

Set FREQUENCY CYCLES PER SECOND control to position 1.

Set MODULATION SELECTOR switch to INT. PULSE position.

Set SYNC & POLARITY SELECTOR switch to INT. MOD. & SQ. WV. position.

c. After the above settings have been made, check for a 10 cps pulse repetition rate. If the pulse repetition rate does not fall on 10 cps then adjust the LOW FREQ. ADJ. R217. The high end of the repetition rate range will automatically fall in and track correctly when LOW FREQ. ADJ. R217 is properly adjusted.

5-7. SETTING THE SQ. WV. SYMMETRY ADJ. R211.

a. Connect the signal generator and test equipment as shown in figure 5-5B.

b. Set FREQUENCY MULTIPLIER control X1000 position.

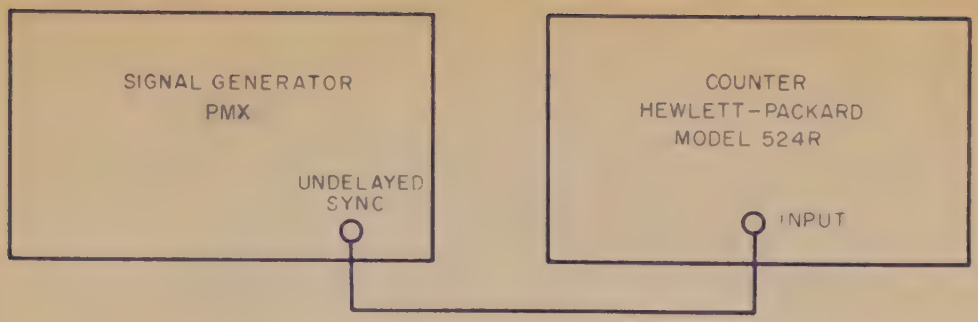
Set FREQUENCY CYCLES PER SECOND control to position 5.

Set MODULATION SELECTOR switch to INT. SQ. WV. position.

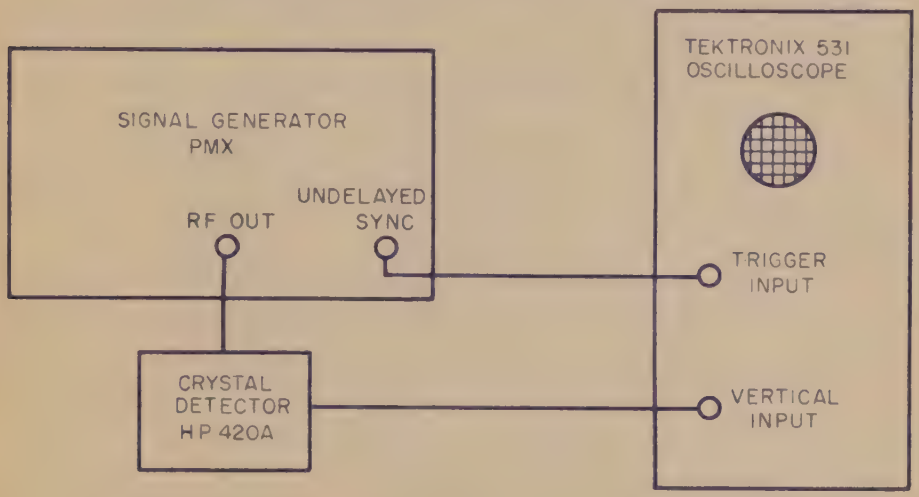
Set SYNC & POLARITY SELECTOR switch to INT. MOD & SQ. WV. position.

c. Using the coaxial crystal detector, feed the detected rf output signal to the Tektronix Model 531 oscilloscope.

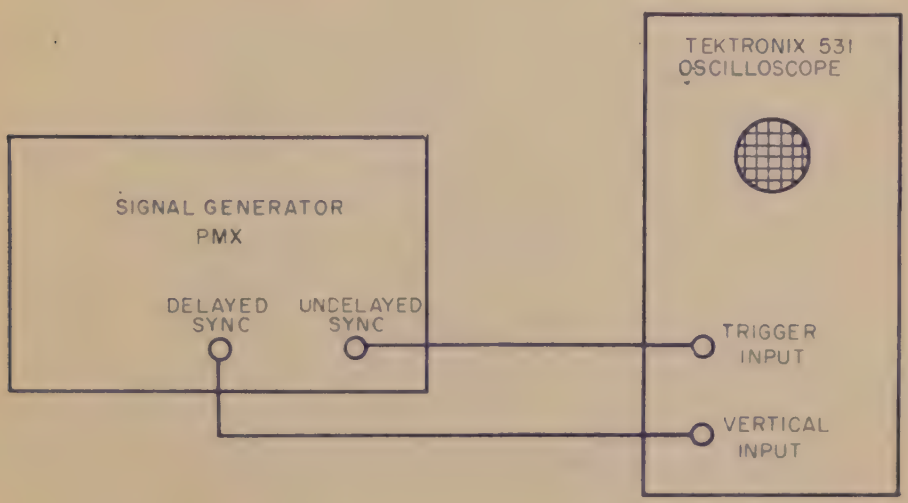
d. Adjust SQ. WV. SYMMETRY ADJ. R211 until the pulse width of the waveform displayed on the oscilloscope is 50% of the repetition rate or when the on and off periods are equal.



(A) TEST SET-UP FOR LOW FREQ ADJ R217



(B) TEST SET-UP FOR SYMMETRY ADJ R211 AND MIN WIDTH ADJ R315



(C) TEST SET-UP MIN DELAY ADJ R233

FIGURE 5-5 ADJUSTMENTS, TEST SET UP

e. Lock the shaft of R211 in the desired position by tightening the locknuts. Recheck the symmetry of the square wave.

5-8. SETTING THE MIN DELAY ADJ R233.

a. Connect the signal generator and test equipment as shown in figure 5-5C.

b. Set SYNC & POLARITY SELECTOR switch to INT. PULSE position.

Set DELAY MULTIPLIER to X1 position.

Set DELAY MICROSECONDS to position 2.

c. Trigger the oscilloscope with the signal from the UNDELAYED SYNC. OUT connector. Feed the DELAYED SYNC. OUT to the vertical input of the oscilloscope.

d. Adjust MIN DELAY ADJ R233 for 2 microseconds spacing between the undelayed and delayed triggers. Lock the shaft in the desired position by tightening the locknut. Recheck the spacing after the locknut has been secured.

e. Potentiometer R238 is factory adjusted. If adjustment is required due to the absence of a delayed sync pulse output, then adjust potentiometer R238 to the point where Blocking Osc. V206B conducts but does not free-run.

5-9. SETTING THE MIN WIDTH ADJ R315.

a. Connect the signal generator and test equipment as shown in figure 5-5B.

b. Set the signal generator for internal pulse operation. Set PULSE WIDTH control to 0.2 microsecond.

c. Couple the rf output of the equipment to the vertical input of the Tektronix Model 531 oscilloscope through the Hewlett-Packard 420A coaxial crystal detector having a 250 ohm termination.

d. Adjust MIN WIDTH ADJ R315 for a 0.2 microsecond pulse width. Lock the potentiometer shaftlock in the desired position. Recheck the pulse width after the lock has been tightened.

POLARAD ELECTRONICS CORP.

CONSULTANTS — DESIGNERS — MANUFACTURERS

43-20 34th Street Long Island City 1, N. Y.

EXeter 2-4500

REQUEST FOR MAINTENANCE

FROM:

COMPANY NAME _____ DATE: _____

ADDRESS: _____ INDIVIDUAL _____

_____ POSITION _____

SECTION OR DIVISION _____ PHONE NO. _____ EXT. _____

_____

EQUIPMENT _____ DATE OF PURCHASE _____

MODEL _____ SERIAL NO. _____ ORDER NO. _____

_____

TROUBLE REPORT:

A. Description of trouble _____

_____

_____

_____

_____

_____

B. Has trouble been localized? _____ If so, how and where: _____

_____

_____

_____

_____

_____

MEXICO 4, D. F. Zurich 8

C. Instruments used and measurements taken, if any: _____

_____

_____

_____

D. Is trouble intermittent? _____

E. Hours of operation prior to this trouble _____

F. Date trouble occurred _____

G. Was factory consulted by telephone or letter prior to this request? _____

If so, give date and person to whom directed: _____

_____

H. Additional Comments: _____

_____

_____

_____

_____

_____

_____

When trouble develops requiring factory assistance, complete this form and send to:

Polarad Electronics Corporation
43-20 34th Street
Long Island City 1, New York
ATTENTION: Service Department

After this report has been analyzed by the Service Department, you will be notified when a field service engineer will call on you to make the necessary repairs. If your trouble can best be corrected at the factory, we will so notify you with instructions and authorization for returning the equipment.

NO EQUIPMENT MAY BE RETURNED TO THE FACTORY WITHOUT WRITTEN AUTHORIZATION

THESE ARE POLARAD REPRESENTATIVES IN THE UNITED STATES AND THROUGHOUT THE WORLD

DOMESTIC REPRESENTATIVES

ARIZONA, CALIFORNIA, NEVADA

T. Louis Snitzer Company
5354 W. Pico Blvd.
Los Angeles, Calif.
Webster 8-2074

T. Louis Snitzer Company
7814 Ivanhoe Ave.
La Jolla, Calif.
Glencourt 4-2191

T. Louis Snitzer Company
510 S. Mathilda Avenue
Sunnyvale, Calif.
Regent 6-6733

ARKANSAS, LOUISIANA, OKLAHOMA, TEXAS, NEW MEXICO

Industrial Associated Electronics
5907 East Lancaster Ave.
Fort Worth, Texas
Jefferson 1-1132
Jefferson 5-2056

ILLINOIS, INDIANA, WISCONSIN

Loren F. Green & Associates
5218 West Diversey Avenue
Chicago, Illinois
Palisades 5-6824

OHIO, WESTERN PA., MICHIGAN

Harvey Teplitz & Co.
3543 Cornell Drive
Dayton 6, Ohio
Crestview 7-9178

Harvey Teplitz & Co.
671 Sycamore Drive
Cleveland, Ohio
Redwood 1-5676

Harvey Teplitz & Co.
19942 Inkster Road
Detroit 19, Michigan
Kenwood 7-9058

VIRGINIA, WASHINGTON, D.C., WEST VIRGINIA

Brimberg Associates
221 Investment Building
Washington 5, D.C.
Decatur 2-8000

ALABAMA, FLORIDA, GEORGIA, MISSISSIPPI, N. CAROLINA, S. CAROLINA, TENNESSEE

Murphy and Cota
2110 Peachtree Road, N.W.
Atlanta 5, Ga.
Trinity 3020

Murphy and Cota
1106 Burke Street
Winston-Salem, N.C.
Winston-Salem 4-0750

Murphy and Cota
1220 Edgewater Drive
Orlando, Fla.
Garden 4-2167

NEW ENGLAND

George Gregory Associates
99 Elm Street
West Newton, Mass.
Bigelow 4-4832

METROPOLITAN NEW YORK CITY

Home Office
Polarad Electronics Corporation
43-20 34th Street
Long Island City 1, N. Y.
EXeter 2-4500

Alfred A. Goldberg
Richard J. Sheloff

NEW YORK STATE (EXCEPT METROPOLITAN NEW YORK)

Northern Associates
704 Allen Road
North Syracuse, N. Y.
Glenview 8-2358

MARYLAND, SOUTH NEW JERSEY, EASTERN PENNSYLVANIA

Eastern Associates
1468 Old York Road
Abington, Pa.
TUrner 4-7200

Eastern Associates
5612 Belleville Ave.
Baltimore 7, Maryland
Liberty 2-1011

MISSOURI, KANSAS, IOWA, NEBRASKA

Engineering Services Co.
4550 Main Street
Kansas City 11, Mo.
Jefferson 1-7765

Engineering Services Co.
6635 Delmar Blvd.
St. Louis, Mo.
Volunteer 3-3661

Engineering Services Co.
4529 South Glenn
Wichita, Kansas
Jackson 4-0111
Jackson 4-8628

Engineering Services Co.
3742 Kencrest Drive, NE
Cedar Rapids, Iowa
EMpire 5-4538

COLORADO, UTAH, WYOMING, MONTANA

McLoud & Raymond
5403 East Evans
Denver 22, Colorado
Skyline 6-1580
Skyline 6-1589

OREGON, WASHINGTON, IDAHO

Hawthorne Electronics
700 S.E. Hawthorne Blvd.
Portland, Oregon
Belmont 4-9375

Hawthorne Electronics
Room 107 Administration Bldg.
Boeing Field
Seattle, Washington
Mohawk 3962

DOMINION OF CANADA

Measurement Engineering Ltd.
Arnprior, Ontario, Canada
Arnprior 400

Measurement Engineering Ltd.
P.O. Box 189
Station O
Montreal, Quebec, Canada

OVERSEAS REPRESENTATIVES

ALGERIA
Bureau de Liaison
113 Rue de L'Universite
Paris 7e

ARGENTINA
Tecnitron
Charcas 1337
Buenos Aires

AUSTRALIA
Electronic Industries
Imports Pty Ltd.
139/143 Bouverie St.
Carlton, N. 3, Melbourne

AUSTRIA
INGLOMARK
Markowitsch & Co.
Mariahilferstr 133
Vienna XV

BRAZIL
Emile H. Staub, S. A.
Rua Libero Badaro, 293
Sao Paulo

CHILE
Goldman, Janssen y Cia Ltda.
Casilla 274
Santiago

CHINA
Nan Jong Instruments Co.
69, Kaifeng Street
Taipei, Taiwan

CUBA
Cia Commercial Herza, S.A.
O'Reilly 504
Havana

DENMARK
Ditz Schweitzer
Bredgade 37
Copenhagen

ENGLAND
Allied International Co., Ltd.
59/61 Union Street
London S.E. 1

FINLAND
Orbis Oy
Lapinladenkatu 17
Helsinki

FRANCE
Bureau de Liaison
113 Rue de L'Universite
Paris 7e

GERMANY
Rohde & Schwarz Vertriebs GMbH
Auerfeldstr 22
Munich

HAWAII
John J. Harding Co. Ltd.
P.O. Box 4013
Honolulu

HOLLAND
I. R. C. A.
92 Parodysstraat
Voorburg

INDIA
B. N. Bose & Company
1st Floor, 8 Waterloo St.
Calcutta—1

IRAQ
Shahine Medawar
P. O. Box 1679
Beirut

ISRAEL
Electronic Equipment
6, Ibn Gvirol
Tel-Aviv

ITALY
Henry C. Milano
Via C. Battisti 2
Torino

JAPAN
Marubun Co. Ltd.
No. 1, 2-Chome,
Odenmacho, Nihonbashi
Chuo-Ku, Tokyo

JORDAN
Shahine Medawar
P. O. Box 1679
Beirut

LEBANON
Shahine Medawar
P. O. Box 1679
Beirut

MADAGASCAR
Bureau de Liaison
113 Rue de L'Universite
Paris 7e

MEXICO
Standard Electrica de Mexi
Calle Madrid 21-F
Mexico 4, D. F.

NEW ZEALAND
W & K McLean, Ltd.
7 Anzac Avenue
Auckland

NORWAY
Morgenstierne & Co.
Colletts Gate 10
Oslo

PERU
V. M. LaPierre & Cia.
Los Alamos 375
San Isidro, Lima

PORTUGAL
Equipamentos de
Laboratorio, Lda.
Apartado 458
Lisbon

SAUDI ARABIA
Shahine Medawar
P. O. Box 1679
Beirut

SOUTH AFRICA
Leigh & Hurwitz (Pty) Ltd.
P. O. Box 3236
Johannesburg

SWEDEN
Electronikbolaget AB
Barangsgatan 30
Stockholm SO

SWITZERLAND
Omni Ray AG
Dufourstr 56
Zurich 8

Manufacturers of Microwave & Electronic Equipment